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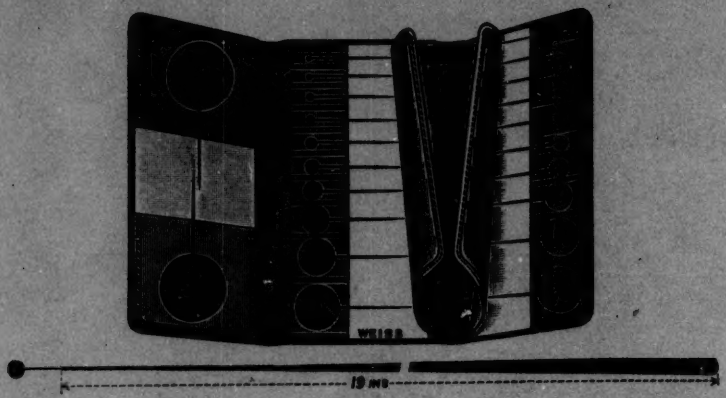

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COMMUNICATION

THE BLOOD-PRESSURE IN THE EYE AND ITS RELATION TO THE CHAMBER-PRESSURE

BY
PRIESTLEY SMITH,
BIRMINGHAM.

(Continued from p. 26)

IN the first part of this article certain physical principles essential to the study of blood-pressure were demonstrated by experiment. In accordance with these principles and with anatomical and physiological data, a schematic line was laid down to represent in a general way the fall of pressure suffered by the blood in travelling from the left ventricle to the right auricle. It was shown that such a line can be true only in a general sense because different blood-circuits would give different pressure-lines and the line for any one circuit would vary with contraction and dilatation of the vessels.

The next step is to test this schematic line by comparing it with actual measurements of blood-pressure in different regions. The test cannot be a very rigid one because, apart from physiological variations, different observers have arrived at different results. Moreover, the instruments employed for this purpose do not tell us exactly what we want to know; they raise the lateral pressure of the blood-stream in the act of measuring it. In clinical work, where the object is to compare the pressure in an individual with

the normal average rather than to learn its absolute value, this source of error is probably of small importance; in an enquiry like the present it cannot be disregarded. The methods must be considered.

In measuring the blood-pressure in an artery of an animal it is usual to divide the vessel transversely and to bind the central end on to the canula of a manometer. The column of mercury or other liquid rises or falls until it balances, and so measures, the pressure of the blood. The flow through the artery is thereby stopped. Between the manometer and the point where the artery leaves its parent trunk or gives off its last branch, the blood-column, though receiving a pulsatory impulse, has no onward flow. The indicated pressure is that of the arrested blood column, not that which was present in the vessel when the blood was moving. It is higher. This is easily demonstrated.

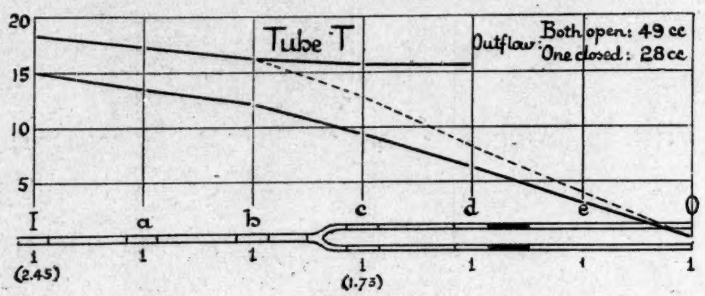

FIG. 25

Shows the effect of closing one branch of a bifurcating tube.

Tube T (Fig. 25) consists of an afferent trunk and two equal-sized branches. In each branch a short length of rubber tube is introduced on the distal side of the point *d*, so that either branch can be closed here by pressure from without. When both branches are open the lower pressure-line is obtained. When one branch is closed the trunk and the closed branch give the upper line. It is pushed up because the total resistence in the tube is now greater than before, the driving-force remaining the same. Over the trunk the upper line slopes less steeply than the lower because the velocity here is now reduced; over the branch it is horizontal because the water here is now stationary. For the open branch we get the broken line: it is steeper than the corresponding part of the original line because the velocity here is now increased. When both branches are closed the line (not shown in the chart) is pushed up to the level of the water in the cistern; it is horizontal throughout because the water is stationary throughout. Suppose this tube to represent an artery

having two equal branches, and the lower line in the chart to represent the lateral pressure of the undisturbed blood-stream. Now suppose one branch to be severed at *d* and tied on to a manometer. The pressure at *d* will rise; the reading obtained, if regarded as a measure of the pre-existing pressure at this point, will be erroneous. It will not even be true for the pre-existing pressure in the trunk above the bifurcation, for the pressure in the trunk is itself raised by the closure of the branch. The amount of the error will be represented by the vertical distance between the upper and lower pressure-lines over the point *d*, and will depend on several circumstances:—

It will depend on the steepness of the normal pressure-line in the region in question. Since the pressure falls more quickly in small vessels than in large, and in short circuits than in long, the errors will be greater in small vessels and in short circuits, provided that equal lengths of the blood-stream are immobilised in the several cases.

It will depend on the length of the immobilized blood-column, i.e., the distance between the cut end of the artery and the last point of branching, for the normal pressure-line for this region would slope downward whereas the manometric is horizontal. Thus in the case of Tube T, if the manometer were placed at *c* instead of *d*, the error would be smaller, while if it were placed at *e* the pressure-line would be lengthened and the error would be greater.

Again, it will depend on the relative capacities of the occluded channel and of the channel or channels remaining open to the

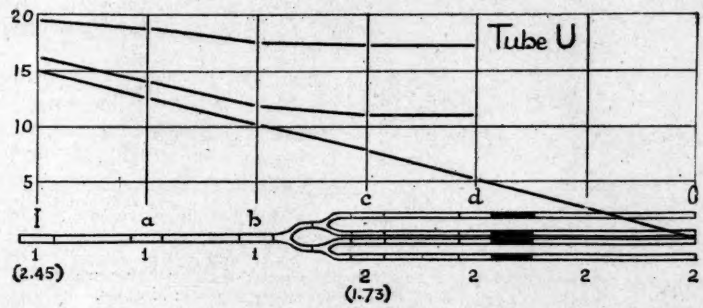

FIG. 26

Shows the effect of closing one or more of several branches.

blood. Tube U (Fig. 26) has four equal branches. When all are open we get the lower pressure-line; when one is closed we get the middle line; when three are closed, the upper line.

And again, it will depend to some extent on the angle at which

the occluded branch springs from the parent trunk. If at a right-angle, then the pressure of the stationary blood will equal the lateral pressure of the moving stream, as in our experimental apparatus. If at a slope in the forward direction, then the stationary blood will bear not only the lateral, but also a part of the forward pressure, and accordingly will be pushed up somewhat more.

Moreover, our experiment omits a factor which is often present in the case of the blood-stream. When we close a branch in our artificial system the driving force remains unaltered, and the increased resistance leads to a proportionate reduction of the output from the cistern. On the other hand, when a large artery is closed, the driving force of the heart usually increases—a purposive reaction tending to maintain the previous output—and a rise of pressure additional to that here demonstrated takes place.

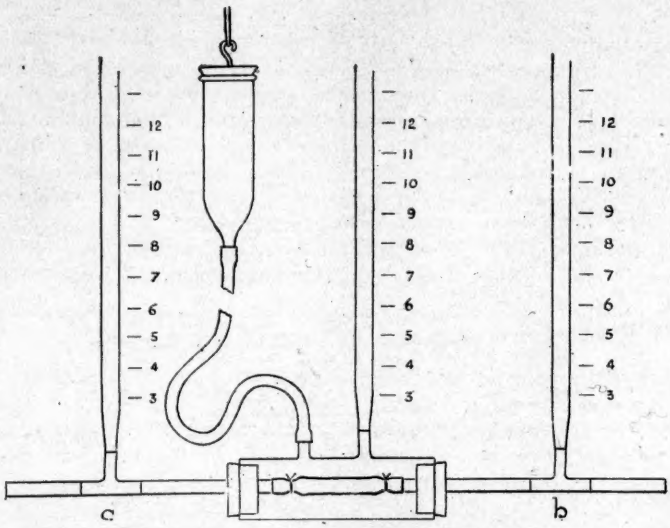

FIG. 27

Pressure-chamber by means of which known degrees of external pressure can be applied to a compressible tube transmitting a stream of water.

The air-bag sphygmometer errs in like manner. In Lockhart Mummery's well-known experiment[5] the canula of a mercurial manometer was tied into the right femoral artery of a dog, and at the same time a sphygmometer having a special narrow cuff was applied to the animal's left thigh. The sphygmometric reading was taken at the moment when the pulse became imperceptible in the

popliteal or posterior tibial artery. Three dogs were examined in this way. Ten pairs of simultaneous readings were recorded, and in only one instance did the two instruments differ by more than 2 mm. Hg. The agreement shows, of course, not that these instruments are capable of measuring the normal blood-pressure correctly, but that in so far as they err they are likely to err about equally.

The following experiments exhibit the kind of way in which the armlet of the sphygmometer disturbs the pressure in the vessels it compresses. Fig. 27 shows an arrangement in which a portion of our usual horizontal glass tube was replaced by a piece of pigeon's gut. Surrounding the gut was a glass chamber with two outlets, one connected with an adjustable reservoir, the other with a graduated vertical tube showing the pressure in the chamber. By this means we could subject the membranous tube to any desired external pressure, and observe the effects on a stream of water flowing through it. Obstruction of the flow was shown by changes of pressure at *a* and *b*, by diminished outflow, and by alteration in the contour of the gut. To understand the latter, one must realize that even in this short length of gut the lateral pressure is lower at the distal than at the proximal end.

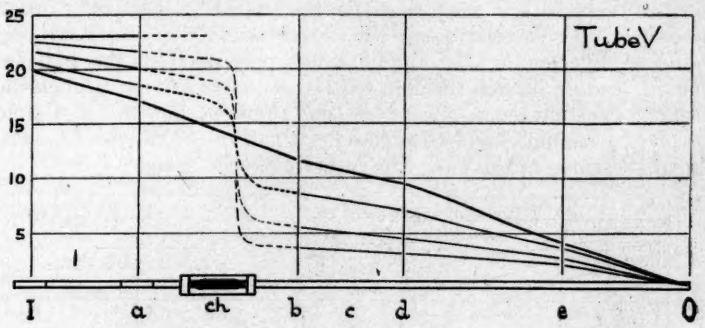

FIG. 28

Represents pressure-changes induced by progressive compression of an artery without compression of the corresponding vein.

In Tube V (Fig. 28) a chamber of this kind was placed about midway along the proximal half. When the chamber-pressure stood at 0, the long heavy pressure line was obtained. The pressure in the gut would then be about 15 c.m.—*i.e.*, a little above the mean of the pressures at *a* and *b*, for the lumen of the gut was greater than that of the glass tube. The chamber-pressure was raised step by step, 2 cm. at a time. When it reached 16 cm. it began to affect the flow through the tube; the gut showed slight compression at its distal end, the pressure-line was altered, the

outflow was reduced; at 18 and 20 cm. these changes became more pronounced. The three thin lines were obtained with chamber-pressures of 16, 18 and 20 cm. respectively; the dotted part of each is inferential. At 22 cm. the flow almost stopped; at 24 cm. it stopped completely, the gut being completely closed. The pressure-line (upper heavy line) was then horizontal, standing like the water in the cistern at 23 cm.

If the air-bag of the sphygmometer could be so applied as to compress an artery without compressing the corresponding vein, the pressure-changes induced would be of the kind seen in Tube V; during gradual compression of the artery the blood-pressure would rise more and more in the region above the bag, and fall in that below it; at the moment of occlusion the pressure above the bag would equal the air-pressure in the bag. But this illustration is not quite satisfactory, for a distended artery has more elastic resilience than a distended gut, and for this reason external pressure would find a stronger auxiliary in the wall of the artery than in that of the gut, and the lumen of the artery would begin to diminish under a relatively lower external pressure.

But the air-bag as ordinarily used compresses veins as well as arteries, and except for some difference in their embedding, the two sets of vessels are subjected to the same degree of external pressure. Their relation to the armlet might therefore have been imitated by turning the tube round upon itself in the half-way region, leading it back through the same compression-chamber, and placing a second piece of gut alongside the first, but it was simpler to place a second chamber in the distal half of the tube and to make equal pressures in the two; the principal is the same.

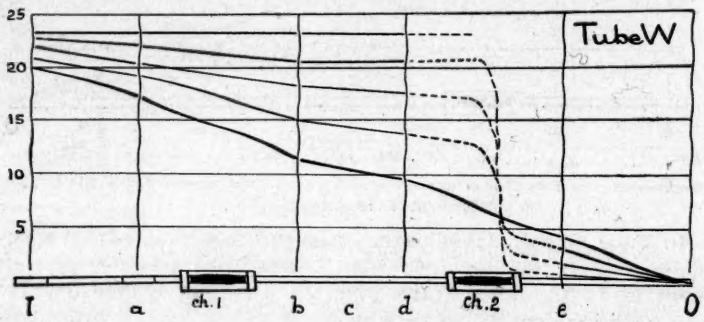

FIG. 29

Represents pressure-changes induced by the armlet of the sphygmometer.

Tube W (Fig. 29) shows what happened when increasing external pressure was applied equally at corresponding parts of the proximal and distal halves—representing the air-bag pressing equally

on arteries and veins. As before, the pressure was raised step by step. When it stood at 0 the pressure-line was almost identical with that of Tube V. The pressure in the distal gut would then be about 7 cm. As was to be expected, disturbance of the flow now began when the chamber-pressure reached 8 cm.; the distal gut showed compression at its distal end, the pressure-line was altered, the outflow was diminished. At 12, 16, and 20 cm. we got respectively the three thin pressure-lines, and the outflow progressively diminished. So far the proximal gut showed no sign of compression; not until the chamber-pressure rose nearly to 24 cm. was it noticeably altered; then it collapsed and the outflow stopped completely.

With these results in view one can easily realize what happens when the air-bag of the sphygmometer is placed round the arm or fore-arm and *slowly* inflated. As soon as the air-pressure in the bag exceeds the blood-pressure in the underlying veins it begins to reduce their lumen in that situation. It does not close them because the venous pressure below the air-bag, being driven up by the oncoming blood, rises with the external pressure. Below the armlet the pressure is driven up in all the vessels—most in the veins, less in the capillaries, least in the arteries—and so tends towards a common level. Above the armlet, while the arterial pressure rises, the venous falls. As soon as the air-bag pressure exceeds the diastolic pressure in the artery the vessel collapses during the diastole, and refills during the systole; when it exceeds the systolic pressure the vessel remains closed. The stationary arterial blood above the armlet has then the same pressure as it would have if the vessel were severed and connected with a mercurial manometer. By inflating the armlet *rapidly*, it is possible to close the artery before the capillaries and veins have had time to become greatly overfilled; and so to avoid painful congestion of the limb.

The object of this digression, the reader may need to be reminded, was to demonstrate that the manometer and sphygmometer raise the blood-pressure in the act of measuring it. Let us now turn to actual readings, and first, to certain remarkable observations published by Poiseuille in 1826[6]. They are sometimes cited, I think, with insufficient reserve.

Working with the U-shaped mercurial manometer invented by himself, Poiseuille investigated the pressure in the larger arteries in a number of dogs and a horse. Using two manometers simultaneously he connected them with different arteries by means of glass tubes filled with salt-solution, and so compared the pressures in different regions. The arteries compared were the common carotid and the brachial, common iliac and brachial, carotid and crural (=femoral of man), carotid and aorta, carotid and renal, axillary and crural, and in the horse the carotid (diam. 10 mm.) and a branch of the crural (diam. 2 mm.). In every instance a

series of readings was taken and the average was struck. In every instance, so far as the record goes, the average pressures at the two points compared were equal. He concluded that "the force with which the blood is driven from the heart retains the same intensity throughout the arteries as far as their smallest ramifications." This conclusion is irreconcilable with well-established laws. Where did the fallacy lie?

Wishing to test Poiseuille's results and knowing the difficulty of making accurate comparisons with separate instruments, Claude Bernard[7] devised a differential manometer which brought the two ends of a single U-shaped mercurial column into connection with the two arteries to be compared; preponderance of pressure in either artery displaced the mercury and was thereby measured. He found that in fellow arteries, e.g., the carotids, the pressures were equal, while in different arteries, e.g., the carotid and the crural, the pressure was higher in the vessel nearer the heart. But on experimenting further with an instrument which showed the rise and fall occurring with each heart-beat, which apparently Poiseuille's did not, he found that the difference between the carotid and the crural pressures was much greater at the moment of maximum than at that of minimum pressure—it belonged to the systole rather than to the diastole.

Further it is important to notice that the smallest artery Poiseuille tested had a diameter of 2 mm., whereas the chief fall of pressure takes place in smaller vessels still. Also that the pressures he observed were not normal pressures; they were raised by the arrest of the blood-stream, and being raised would be more nearly level with each other and with the aortic pressure than are the normal pressures. And after all, even if the mean-pressures in such arteries as the carotid and the femoral *were* proved to be equal or nearly so, this would not justify Poiseuille's conclusion even for the larger arteries. The carotid and the femoral belong to different circuits one longer than the other, but these circuits have identical end-pressures, aortic and caval. Assuming that they are destined to supply their respective capillary areas with blood at about equal pressures, we should reasonably look for equal arterial pressures not at *equal*, but at *proportional*, distances from the heart. But such equality, if proved, would tell us nothing of the fall occurring between the heart and these arteries. To ascertain the form of the pressure-line we must know the pressures at different distances from the heart in one and the same circuit, and it is the mean pressure that we want to know.

What is the mean pressure in the *arch of the aorta*? Since the innominate and common carotid arteries spring from the aorta at right angles, a mercurial manometer applied to either of these branches would show the aortic pressure correctly, were it not that

obstruction of so considerable a branch must raise the pressure in the trunk (see Tube T). In an animal thus tested the normal pressure in the aorta must be rather lower than that indicated by a manometer applied to the innominate or common carotid artery. In healthy young men the average mean aortic pressure is estimated by Leonard Hill[8] at 120 mm. Hg., or a little more, on the supposition, apparently, that it cannot be much higher than the brachial pressure. It increases with age, and some authorities put the normal average a good deal higher, but to run no risk of over-estimating it, let us take it as 120 mm. Hg. in healthy young men.

In the *brachial artery* of healthy young men Leonard Hill—using the armlet-sphygmometer, and taking the maximum oscillation of the pointer as his indication—found mean pressures varying from 110 to 130 mm. Hg.: say, average about 120, and from this something may be deducted on account of the arrest of flow. George Oliver's figures[9] give a lower average: about 108 mm. Hg. according to his earlier measurements; about 95 when the auditory method of determining diastolic pressure had been adopted. These figures are not expressly given by him, but represent the half-way between the mean of his diastolic and the mean of his systolic pressures in the young adult.

Between the *upper arm* and the *forearm* Oliver could detect no fall of pressure. Between the *wrist* and the *first phalanx* of the finger, a much shorter distance, he found a fall of 5 to 15 mm. Hg., *i.e*, to 90 or 85 mm. Hg. Why this sudden step downward, instead of an even descent? Possibly it was more apparent than real. In the fore-arm, where there are two bones, the arteries are said to be rather less accessible to the pressure of the air-bag than in the upper arm, where there is only one. If this be so, they may need the same degree of bag-pressure for their occlusion, although their blood-pressure is a little lower. As to the fall at the wrist, it is worth noting that an air-bag round the wrist obstructs the whole of the blood-supply to the fingers, whereas one round a single finger obstructs about one-fifth of it; the pressure may therefore be more pushed up at the wrist than at the finger (see Fig. 26).

In the *second and third phalanges* of the finger, Oliver found a rapidly-increasing fall; the pressure in the *ungual phalanx* was rather less than half that in the brachial artery, *i.e.*, somewhere about 50 mm. Hg.

In the *cabillaries of the finger* von Kries[10] measured the pressure by laying a small glass plate of known area on the pink skin at the root of the nail and weighting it progressively until the skin grew pale. On a level with the heart, in the sitting position, it appeared to be about 38 mm. Hg., *i.e.*, nearly one-third of that in the aorta. But the method is not very trustworthy, for since the cuticle has

some rigidity, the pressure of the plate is not accurately confined to the area it covers, and since this area is small the error so arising may be considerable. Oliver measured capillary pressure by noting the height above the apex of the heart at which the matrix of the nail grows pale. The height in inches multiplied by 2 gives an approximate equivalent in mm. Hg. It was found to vary much with the temperature of the hand, and with degrees of muscular effort; in the sitting position, when the hand was warm, it was commonly from 25 to 30 mm. Hg.

In the ***dorsal veins of the hand*** Oliver measured the pressure by the same method. The hand is raised gradually and the observer notes the height at which the veins visibly collapse—a method obviously good in principle, but applicable only if the veins are fairly prominent. In the sitting position the pressure was commonly 15 to 20 mm. Hg.

For the pressures in the ***larger veins*** we have to look to experiments on animals. In a sheep, during normal quiet respiration, Jacobson[11] found 9 mm. Hg. in a branch of the brachial vein; 4 in the brachial itself; and amounts hardly distinguishable from 0 in the subclavian, jugular and innominate. In these latter, and in the main trunks near the heart, the pressure is negative during inspiration, positive during expiration, and on the average probably not far from 0.

These figures, though wanting in precision, suffice to show that a pressure-line for the circuit in question would bear a general resemblance to the one we arrived at by other means for the blood-stream as a whole. Thus they show a slight fall in the region of large and middle-sized arteries, a much greater fall in the region comprising arterioles, capillaries, and veins, and again only a very slight fall in the middle-sized and large veins. Speaking roughly, they show a fall of about 30 mm. Hg. between the aorta and the base of the finger, 70 or 75 in the finger itself, and 15 or 20 between the base of the finger and the vena cava. They agree with our schematic line in placing the average capillary pressure at something between one-fourth and one-fifth of the aortic, though on this last point no stress can be laid, for capillary pressures vary greatly. Perhaps our original line (Fig. 24) falls rather too quickly in the first third of its course. In Fig. 30 it is a little modified in that respect, and the pressures are shown in mm. Hg. instead of percentages of the total fall.

The general form of the line (Fig. 30) finds a rational explanation when the requirements of the body are considered. The blood performs its essential work in a very small part of each circuit; the minute channels near the half-way point are its place of business, the larger tubes merely carry it to and fro. But in this small part great variations of supply are needed, e.g., for temporary activity in

a secreting gland, for repair of a lesion, or for defence against an irritant, and it is just because the pressure of the blood is maintained at a high level so far along every arterial path that dilatation of small vessels can greatly increase the volume and the pressure of

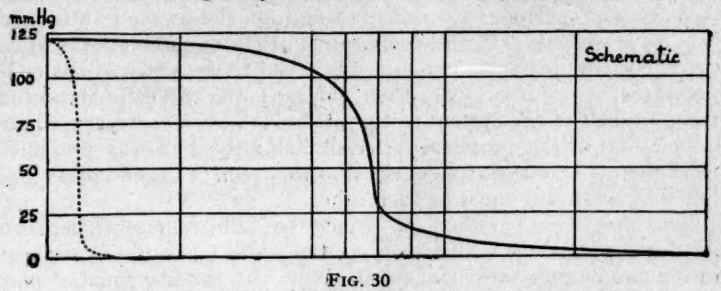

FIG. 30
Schematic pressure-line of blood-stream in a long and a short circuit.

the blood in a limited area that needs it, without disturbing the flow in neighbouring regions that do not. High pressure is everywhere near at hand. Did the pressure of the blood-stream fall evenly from aorta to vena cava—as it might do if the dimensions of the channels were adapted to that end—this isolated flooding of small areas would be far less possible than it is.

The steepness of the line, as already said, varies with the path taken; the shorter the path the steeper the line. A particle of blood that is carried from the left ventricle to the right auricle through the coronary vessels, travels perhaps one-tenth as far as one that goes by way of the arm and finger tips, yet the fall of pressure is the same in the two cases for the end-pressures are the same. Hence if the continuous line in Figure 30 is fairly true for the longer circuit the dotted line will be so for the shorter.

One is apt to imagine that capillaries remote from the heart, e.g., those of the finger-tips or nose, have, ***by reason of their remoteness,***

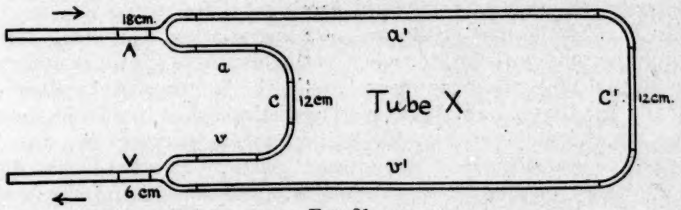

FIG. 31
A long and a short circuit with equal pressures at the half-way points.

a lower lateral blood-pressure than those lying nearer to it, but the idea is ill-founded. It is easy to show that in circuits having the same end-pressures the halfway pressures are independent of the distances travelled. In Tube X (Fig. 31) the water passes from

A to V by two paths, one longer than the other. The trunks A and V are equal: the branches a, a^1, v, and v^1, are all of equal diameter, and in each case the aggregate cross-section of the two branches equals that of their stem. The pressures are measured at A, V, c and c^1. Under a certain driving force the pressures at A and V were respectively 18 and 6 cm., and in each circuit—as was to be expected—the half-way pressure was equal to the mean of the end-pressures, viz., 12cm. We then enlarged the whole of the distal (venous) half of the system so that its cross-section was everywhere double that of the proximal (arterial) half: the half-way pressures were then of course no longer equal to the mean of the end pressures, but they were still equal to each other.

This may seem paradoxical. Since the fall of pressure between A and V is the same whichever path the water takes, the resistances in the two circuits must be equal How can they be equal, it may be asked, when one circuit is longer than the other? The answer is that the velocities are unequal. The stream in the longer circuit is the slower by an amount which equalizes the resistances. But such differences of velocity, it may still be urged, cannot be the rule in the blood-stream, for the needs of the body would not be met if the more distant capillaries had always to accept a slower current than the nearer. No, they are not under that disadvantage. In our tube X we could equalize the velocities at c and c^1 without disturbing the equality of pressure by increasing the lumen of the tubes a′ and v′. And so it is with the blood-vessels; where an artery divides to feed regions at unequal distances it usually divides unequally, the blood for the remoter region being provided with a larger channel. By this means (with adjustments to compensate the effects of gravity) the capillaries in all parts of the body might be supplied with blood under equal pressure and equal velocity were this requisite; in reality differences are required. We know that *temporary* variations are constantly occurring, and there is reason to suppose that different parts need *persistent* differences.

In Fig. 30 the part of the pressure-line relating to the capillaries cannot be differentiated, for whereas the line there shown relates to a circuit of 1,000 mm. or more in length, the length of a capillary is usually less than 1 mm. If it is to be distinguished it must be shown on a larger scale as in Fig. 32. Should this part of the line be steeper or less steep than the adjacent parts? In other words, does the pressure of the blood fall more rapidly or less rapidly in the capillaries than in the arterioles and venules? It is a question of relative resistance. If a group or plexus of capillaries, 1 mm. in length, offers more resistance to the blood-stream than does 1 mm. of the arteriole that feeds them, the line will be steeper over the capillary region (aa), if less, it will be less steep (bb). We know that the lowering of velocity in the capillaries tends *per se* to lower

the resistance, and that the increase of friction-surface tends to increase it, but what is the net result?

Fig. 33 is schematic. It is so proportioned as regards the size and number of the tubes as to offer equal resistance per unit of distance in the several regions. Thus, in travelling 1 mm. through the 16 tubes in region *e* a liquid would encounter the same amount of resistance as in travelling 1 mm. through the single tube *a*, or the two tubes *b*, and so on. The proportions are determined by

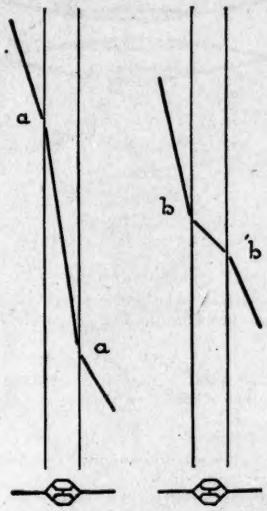

FIG. 32

Possible changes in slope of pressure-line over capillaries. Schematic.

the rule: *square the total cross-section in each region and divide by the number of tubes in that region; the products are inversely proportional to the resistances.* Experimental proof that these proportions give the result stated is given by tube Q where the four branches bear the same diameter-ratio to the main trunk as do those in Fig. 33 and the pressure line is straight (Fig. 17, page 20).

At first sight this figure suggests a contradiction. The right half is an exact counterpart of the left, and the cross-section at the half-way point is four times greater than at each end; therefore, according to the principle already demonstrated (p. 11) the pressure at the half-way point must be greater than the mean of the end-pressures—the pressure-line must be pushed upwards towards the middle. Yet if the resistances are equal in the several regions the corresponding segments of the pressure-line will slope equally, and it would seem that the whole line should be straight. The paradox

disappears when we regard not only the resistances calculable from the size and number of the tubes, but the additional resistances arising at the points of bifurcation and reunion.

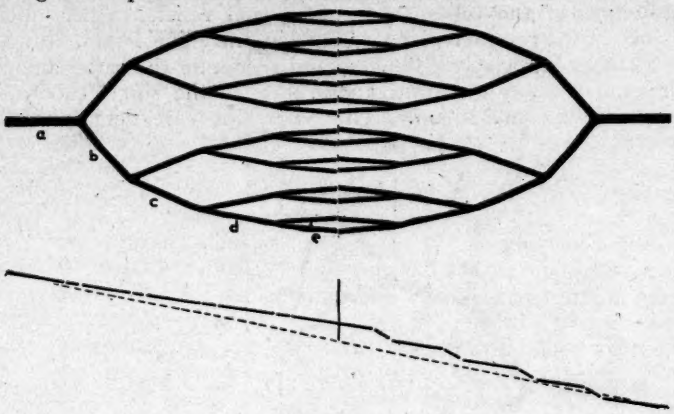

FIG. 33.

A schematic ramification which would offer equal resistance (per unit of length) in each region. The proportions are as follows :—

Region	a	b	c	d	e
Number of tubes	1	2	4	8	16
Diameter of each tube ...	1	0·84	0·71	0·6	0·5
Total cross-section of tubes	1	1·42	2·	2·9	4'
Velocity	1	0·78	0·5	0·34	0·25
Aggregate resistance ...	1	1	1	1	1

To ensure accuracy the figure was drawn on a much larger scale and reduced by photography.

The steepness of the pressure-line is here reduced for convenience; it would vary with the velocity of the stream.

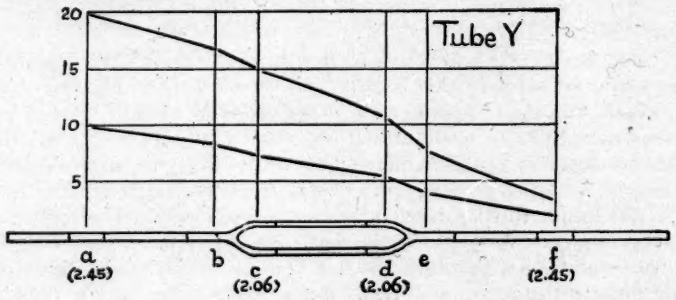

FIG. 34.

Proportions as in Fig. 33. Analysis of pressure-line.

By means of Tube Y (Fig. 34) we experimented with a single bifurcation and a single reunion having the same proportions as those in Fig. 33. We had thus a symmetrical system comparable with

Tubes D, E, and F (p. 8), but by measuring the pressures immediately above and below the points of branching we analysed the pressure-line more minutely than before. The two lines shown in the chart were obtained with two different degrees of driving-force; the upper represents a stream disturbed to some extent by eddies, the lower an approximately steady stream. It is evident that the

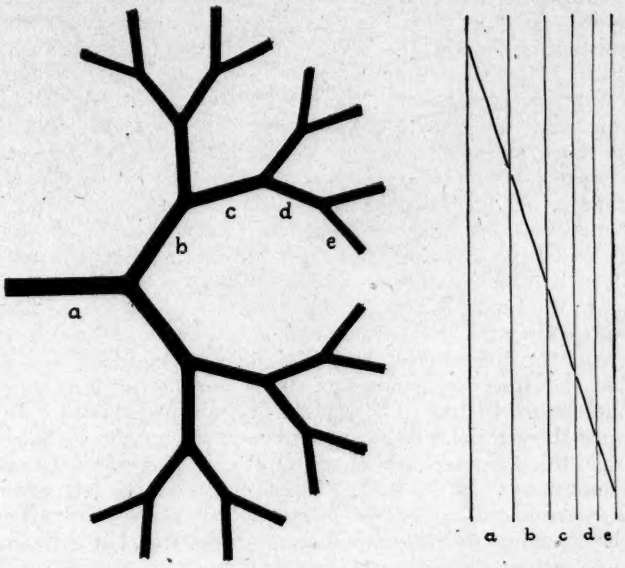

FIG. 35

Schematic ramification for comparison with branching blood-vessels. Proportions as in Fig. 33. Resistances equal in the several regions.

additional resistance was smaller at *b c*, where the trunk divides, than at *d e* where the branches reunite, although the stream is equally deflected in the two regions. Why this difference? The velocity alters differently in the two regions; the ***diminution*** of velocity between *b* and *c* tends to counteract the additional resistance due to the deflection, whereas the ***increase*** of velocity between *d* and *e* supplements it. Proof of this is afforded by Tube D where the branching involves no change of velocity and the additional resistance is the same in the two regions.

Applying this observation to the case of Fig. 33 we may infer that the pressure-line of that system would be of the character there shown, i.e., approximately straight in the proximal half, step-like (or rather sinuous) and somewhat steeper in the distal, and thus showing a half-way pressure greater than the mean.

Fig. 35 reproduces the proportions of Fig. 33 in a form more easily comparable with ramifying blood-vessels. Observe that each stem divides into two equal branches, and that the diameter-ratio of stem to branch is always 1 to 0·84 (approximate); also, that after four bifurcations, whereas the number of tubes is increased from 1 to 16, the diameter only falls from 1 to 0·5.

By comparing these proportions with those of branching blood-vessels it is possible, in favourable situations, to ascertain whether the resistance offered to the blood-stream increases or diminishes as the channels increase in number. In the case of good-sized arteries that bifurcate symmetrically there is no difficulty. We measured stem and branches near to the bifurcation of the following arteries, taking the average diameter of the branches when they were not quite equal; abdominal aorta (two), common iliac (two), popliteal, innominate, small arteries from the surface of the brain, and some from muscles. In every instance the diameter-ratio of stem to branch was greater than that in the schematic figure; it varied from 1 : 0.8 to 1 : 0.6; in other words, in every case the resistance was greater in the branches than in the stem.*

Comparison with arterioles and capillaries is more difficult, partly because of the difficulty of obtaining adequate material, and partly because the free anastomoses of these small vessels upset one's computations. Figure 36 is from an injected preparation. In this specimen the arterioles bifurcate symmetrically in many places, and, as a rule, the diameter-ratio of stem to branch is greater than in the schematic figure, e.g., 1 : 0.75, 1 : 0.66, etc., as in the larger arteries. With regard to the capillaries—better seen in the specimen than in the photograph—precise computation is impossible, but in proportion to their numbers they are certainly small in diameter as compared with Figure 35. Unfortunately artificial injection cannot be trusted to show these small vessels in their natural proportions; in this specimen some vessels are unequally distended in different places and many of the capillaries, though injected, remain too small to admit a blood-corpuscle. One wants to see them injected with their own blood.

Figure 37 shows a group of capillaries in the web of a frog's foot. The frog having been pithed, the web was examined while the blood was still circulating. When the movement ceased a

*In the case of the larger arteries we cut rings from stem and branches a few mm. above and below the fork. Each ring was opened and laid out flat between two plates of glass and measured as to the length of its inner surface; this gave the circumference. In the case of smaller vessels the entire fork stripped of its adventitia was flattened between plates of glass and measured with the micrometer; this gave the external semi-circumference. The diameters were calculated. They were, of course, not those proper to the vessels during life, but the ratio of stem to branch was probably unaltered. In the case of microscopic preparations the measurements were made by projecting the image on to millimetre paper by means of the Leitz drawing-prism, the magnification for each power having been previously ascertained.

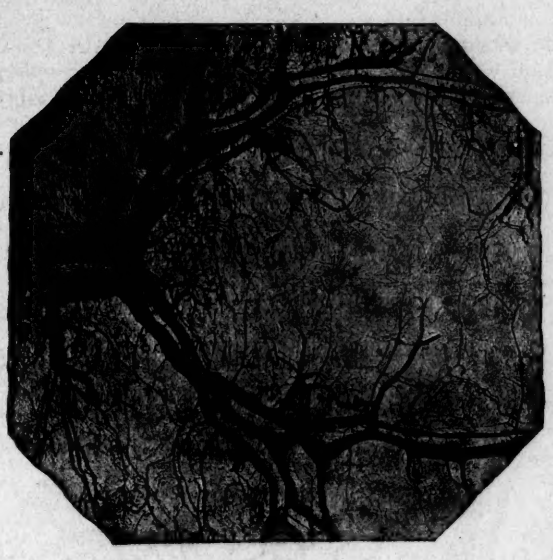

FIG. 36

Blood-vessels in sub-mucous coat of small intestine of cat, injected. × 36 diams.
(Specimen from Prof. Carlier's collection.)

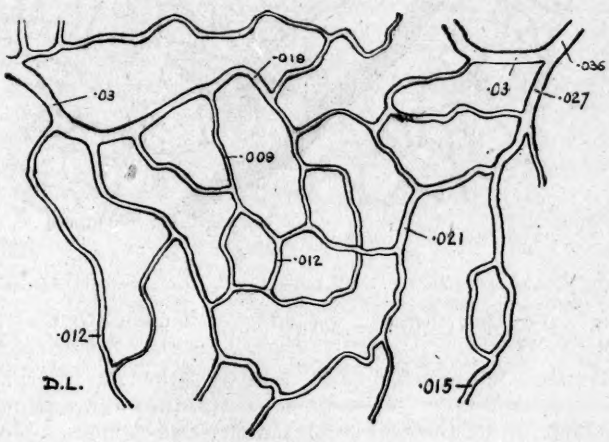

FIG. 37

Prism-drawing of capillaries in web of frog's foot, not artificially injected, but containing blood. × 60 diams. The figures show diameters as measured in the specimen.

ligature was applied to retain the blood in the foot, and the part was removed and placed in normal saline with 4 per cent. of formalin; it was mounted in glycerine jelly. The capillaries were of various sizes. Those of about 0·008 mm. diameter contained a single file of well-shaped corpuscles, some smaller ones contained compressed sausage-shaped corpuscles, and a few smaller still were blocked at the ends by corpuscles which had been unable to enter them. All the channels seen in the drawing contained blood. The stem on the left has a diameter of 0·03 mm. Its resistance (per unit of length) would be equalled by that of 8 capillaries of 0·018 mm. diameter, or 16 of 0·015, or 32 of 0·012. It is possible

FIG. 38

Retinal capillaries of a child, six months old—after W. His. Reproduced from Leber's article in the Graefe-Saemisch Handbook, 1903, Vol II, Section ii, p. 14. *Aa*—arteriæ afferentes. *Ve*—Venæ efferentes. The arrows show direction of flow. In the original the artery is coloured red, the vein blue. Here the artery is darker than the vein.

that the stem served a few more capillaries than are here shown, but according to the measurements it is probable that in this membrane, as in the previous example, the capillaries offered a somewhat higher resistance than the corresponding arterioles.

This probability is the greater because the calculation applies to the resistances in a homogeneous fluid, whereas the blood contains particles which make the resistance relatively higher in the smaller

capillaries; where the corpuscles move in single file and nearly fit the channel, the resistance is relatively greater than where the blood can move like a homogeneous liquid—more rapidly in the axis than at the periphery of the channel.

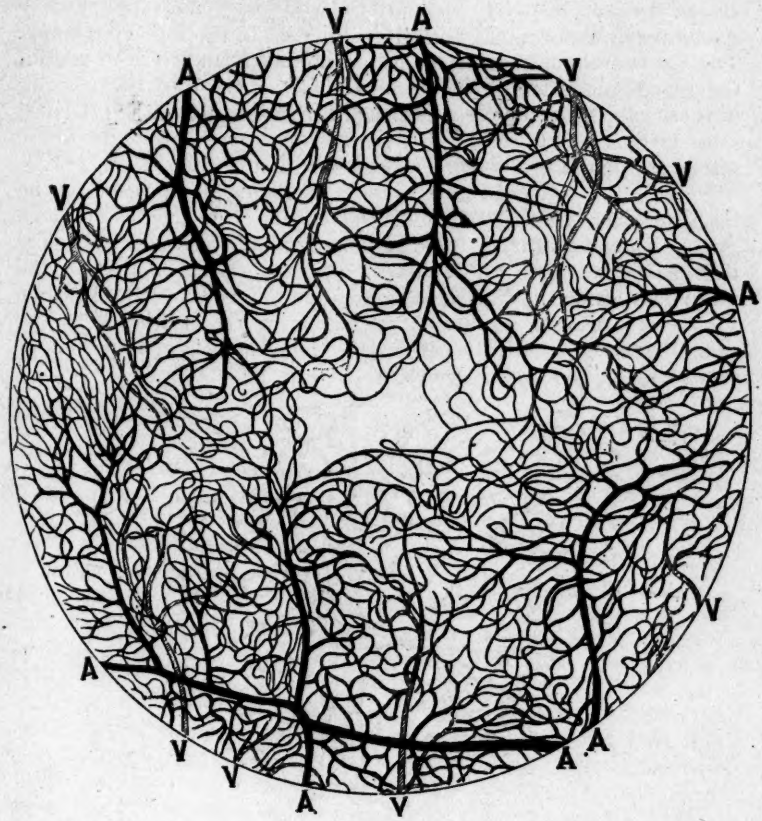

FIG. 39

Drawing of the retinal vessels in the neighbourhood of the macula lutea, from an injected preparation by H. Mueller. Reproduced from Leber's article in the Graefe-Saemisch Handbook (see above) p. 11. In the original the arteries are coloured red, the veins blue; here the letters A & V are added to distinguish them. × 50 diams.

Figure 38 shows part of a small artery in the retina giving off at right-angles a series of branches *Aa* much smaller than itself—three are included in the picture. What are the relative resistances in one of these arterioles and the capillaries it feeds? Here the branches are so little smaller than their stem, and are yet so numerous, that if we may trust the drawing it seems probable that

the arteriole offers (per unit of length) as much resistance as the capillaries, if not more; and this seems probable for other reasons also, when the position of these capillaries is considered. They lie between an artery and a vein much larger than themselves, in other words, between relatively high arterial and low venous pressures—as compared, for example, with the capillaries in the following figure. The pressure-line of the blood that crosses from artery to vein in this place must therefore be comparatively steep, and the velocity in these capillaries, unless it is checked by resistance in the arteriole, must be comparatively high, higher than in the capillaries around the macula, which is not likely. (See description of tube X, Fig. 31.)

Figure 39 shows the retinal vessels in the neighbourhood of the macula. Here there is no sudden fall in size; the arteries diminish gradually as they branch, and there is no evident reason for supposing that the resistance in the capillaries differs greatly from that in the ultimate arterioles. The same impression is received, I think, when the vessels around one's own macula lutea are scrutinised by the pinhole method, or better, perhaps, in the clear field of a microscope while the head is slightly moved.

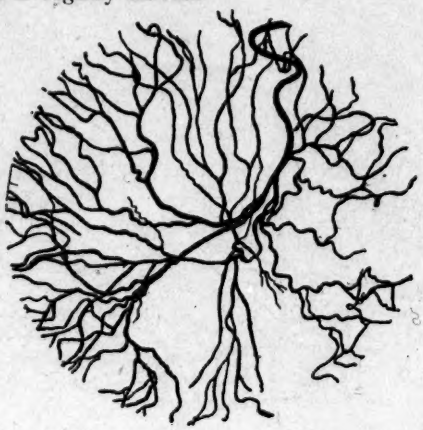

FIG. 40

Drawing of hyaloid artery, and its branches on posterior surface of lens—from an injected preparation by Lawson Tait. × 16 diams.

Figure 40, drawn from a well-injected preparation of the hyaloid artery and its ramification on the posterior surface of the lens, shows quite exceptional proportions; the stem, which has a diameter of 0.035 mm., divides and subdivides until, near the lens-margin, there are about 70 branches; the majority of these measure about 0.015 mm., some rather less, and some as much as 0.02 mm.; if they all measured 0.015 mm., the resistance in the stem would be to that in the 70 branches about as 2.4 to 1.

This question as to the relative resistances in arterioles, capillaries and venules has been variously answered. Some writers assume that the maximum resistance occurs in the arterioles, some attribute it to the capillaries; one has even placed it in the venules. B. Lewy[12] attempted to solve the problem mathematically, but unfortunately the data he adopted are inadmissible. He assumed, for example, that every artery has two corresponding veins, and that the diameter of each vein is to that of the artery as 1·5 to 1, proportions widely differing from those which exist in the retina and other parts where accurate measurements have been made. The evidence given in the present paper, although scanty, shows, I think, that no sweeping statements on the subject are safe.

When all the factors are considered—the proportions of the channels as to size and number, the increasing frequency of bends and tortuosities towards the half-way point, and the disproportionately high resistance in channels that admit only a single file of corpuscles—the probability seems to be that the blood-stream, as a rule, encounters more and more resistance (per unit of distance travelled) as it sub-divides, and finds the maximum where the channels are most numerous, and where its essential work is done, namely, in the capillaries; but that variations in this respect are present in different parts, and occur in the same part at different times.

There is no reason, then, to deflect the schematic line (Fig. 30) over the capillary region. It reaches its greatest steepness here. At the point, not precisely determinable, but probably near to the middle of the capillary region, where the resistance begins to diminish, its curvature passes insensibly from convexity to concavity. There is no reason to introduce a sudden deflection at any point. Such modifications of the line as different organs or parts may give must be separately studied.

The reader who has persevered so far may suspect that the original purpose of this paper has been abandoned, but that is not so. It appeared indispensable to consider the blood-stream as a whole before attempting to learn its special characters in the eye.

(To be concluded.)

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ANNOTATIONS

A Much-needed Reform

Among the many duties of the State the examination of the physical fitness of the candidates for the various branches of its service is not least important. Many have defects of vision, and the different departments of the Government have drawn up regulations as to the standards of vision which the candidates are required to possess in order to qualify for particular posts and occupations. Thus vision testing in some form or other is one of the functions of officials of such widely diverse departments as the War Office, the Admiralty, the Post Office, the Board of Trade (Mercantile Marine Department), as well as other sections of the Civil Service. The preliminary testing is usually of a simple character and does not require very complicated apparatus, yet it is only fair to the candidates that the conditions should be so arranged that the results are strictly comparable to the standards. As a matter of fact this is seldom the case. Visual acuity, for instance, is estimated in terms of Snellen's test types. Every ophthalmic surgeon knows that the estimate varies very considerably according to the illumination of the types; yet no official regulations of any department state the illumination of the standard, and in actual practice the illumination may vary from bright diffuse daylight to dull artificial light, i.e., many hundred candle-powers. This is but one of many criticisms which might be made. These tests use the language of science: many of them are utterly unscientific, and in their practical application no pretension is made to scientific accuracy. It is no exaggeration to say that there are many regulations relating to eyesight now in force which arouse the caustic humour, and often the moral indignation, of ophthalmologists. All these regulations require revision by competent experts, those *bêtes noires* of officialdom. There should be a standing committee of the best ophthalmologists in the country to deal with these and the many other problems relating to eyesight. The committee should be appointed by the Government after consultation with the Ophthalmological Society and the Ophthalmological Section of the Royal Society of Medicine. It should not be attached to any special Government department, but it should be made compulsory for all departments to refer such matters to the consideration of the committee for report.

Owing to the inadequacy of the existing tests, and other causes, it has been found necessary in many departments to allow an appeal from the decisions of the ordinary examiners. In several cases the candidates are required to pay a substantial fee to enable

them to avail themselves of this concession. The conditions under which these appeal examinations are carried out are often lamentable. Rooms quite unfitted for the purpose are used, the test types are badly illuminated, and ophthalmoscopic examination and retinoscopy are done under the most unfavourable conditions. When one realizes that the candidate's future career may depend upon the result of the examination, and that in many cases a fee has been exacted as a token of good faith—surely as much on the part of the State as on that of the candidate—it cannot be denied that some reform is urgently demanded. Under existing circumstances each department makes its own arrangements, and in at any rate one department, it avails itself of the private apparatus belonging to one of the examiners. In this case certainly no fault is to be found with the conditions, but the method is not one which it is desirable that the State should sanction. The obvious way out of the very trivial difficulty is to have one central, properly equipped examination hall, provided with dark rooms, laboratories, &c., for the use of all the departments.

Ophthalmology in Italy.

In the September number of this journal we published some account of the beneficent work that is being accomplished in America by the National Committee for the Prevention of Blindness, a Committee largely composed of clear-headed business men who are able to see far enough ahead to recognize the commercial value of such work to the State. To judge from a contribution by Dr. Alajmo, of Girgenti, in the May-June number of the *Annali di Ottalmologia e Clinica Oculistica* of this year, some similar patriotic action is badly needed in Italy. The point that has roused him to a height of wrath that may be described as dithyrambic—he quotes Ovid and other classical authorities—is the recommendation of a recent Royal Commission for the reform of University study to abolish the study of ophthalmology. We can only hope that there must be some misunderstanding, but, should the facts be as stated, we do not think that Alajmo transgresses the limits of fair controversy in referring to the members of that Commission as "*rimbambiti*," childish idiots. He refers to the noble traditions of Italian ophthalmology, instancing men like Barth, the founder of the Vienna School. He complains bitterly that the modern Italian seems to regard ophthalmology as an almost negligible branch of medicine. His indictment is a very heavy one. Thus, though the loss of a finger in war carries an indemnity, there is no compensation for the loss of an eye. Trachoma is rife and yet there is no compulsory notification or treatment for that terrible scourge. In the question of this complaint our own hands are not too clean, as any worker in the East End of London can testify. Again, he

complains that the sale of glasses is largely in the hands of ignorant quacks. A recent and important work entitled "Contributions to Social Hygiene and Pathology," by Professor Devoto, of the Milan Clinic, for the study of these questions contains no mention of ocular maladies. The result of public neglect of the eye is seen in the almost cynical way in which loss of an eye is regarded by the poorer classes; thus many men destroy an eye with the object of avoiding military service. Legislative measures for the protection of workers against such diseases as ankylostomiasis and malaria are enforced, but there are no measures taken to protect the eyes of the reapers from a common form of keratitis which claims many victims every year.

We fear that the difficulty of inducing politicians to look ahead will always militate against the enforcement of necessary but unpopular measures like the compulsory notification of trachoma. Even from the lowest commercial point of view the loss caused by preventible blindness—and how much blindness is preventible is well known to every ophthalmic surgeon—should cause governments to take strong action in such an important matter.

Professor Cirincione adds a note on the great improvement that has taken place in the ophthalmic arrangements for the Army. As he points out, Italy, like the rest of the Allies, was quite unprepared for war on a large scale, and had to improvise a service. Naturally mistakes occurred at the beginning which are now being put right. He is able to note with great pleasure the decision of the military authorities to use trachomatous recruits, first collecting them into special centres for treatment. He hopes that in this way trachoma may be brought under control as has been done in the last ten years in the Austrian Army. The recruits from Silesia and the lower Danube regions formerly gave 26 per cent. of trachomatous subjects, which has now been reduced to less than 1½ per cent. In addition to the beneficial results of treatment, the numerous cases in which trachoma has been deliberately inoculated in order to avoid military service will disappear. Cirincione goes as far as to say that the war may prove a blessing in disguise if it results in getting control over the dreaded scourge of trachoma and removing Italy from her present sad position as the leading European country in the statistics of contagious conjunctival disease.

ABSTRACTS

I.—AETIOLOGY

(1) **Dean, L. W. (Iowa).—Report of ocular findings in two cases of xeroderma pigmentosum.** *Ophthalmology*, July, 1915.

(2) **Woods, Hiram (Baltimore).—Ocular phenomena accompanying three cases of gastro-intestinal disorders.** *Ophthal. Record*, November, 1915.

(3) **Brawley, Frank (Chicago).—The consideration of systemic diseases affecting the ocular tissues.** *Ophthal. Record*, November, 1915.

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(6) **Haskin, W. H. (New York).—Diseases of the eye in focal infection of the teeth.** *Dental Cosmos*, Vol. LVIII, No. 9, 1916.

(7) **Krauss, F., and Horton Brown, S. (Philadelphia).—Optic atrophy. Observations on a series of cases of unusual interest.** *Ann. of Ophthal.*, April, 1916.

(8) **Cohen, Martin (New York City).—Two cases of metastatic ophthalmia, consecutive to pneumonia.** *Arch. of Ophthal.*, Vol. XLV, No. 3, May, 1916.

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(11) **Standish, Myles (Boston).—Retrobulbar neuritis with central scotoma from toxic action of thyroidin.** *Arch. of Ophthal.*, Vol. XLV, No. 5, September, 1916.

(12) **Beck, Joseph C. (Chicago).—Intimate relation between the eye and the ear, nose and throat, with report of some unusual cases.** *Ann. of Ophthal.*, October, 1916.

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(16) **Demaria (Buenos Ayres).—Observations on cases of severe bilateral iridocyclochoroiditis in subjects with vitiligo. (Consideraciones sobre casos de iridociclocoroiditis doble y grave, en sujetos con vitiligo.)** *Arch. de Oftal. Hisp.-Amer.*, July, 1917.

(1) **Dean** reports two cases of xeroderma pigmentosum with ocular changes, and refers to a third case communicated by Edward Jackson, of Denver,

CASE I.—A female, aged 8. The skin eruption began on face and hands at age of two-and-a-half years. The child was pinched-looking and small for her age. There was scarring of the lids, and atrophy and shrinking of the skin of the face and ears. Scattered over the face were eleven large tubercle-like formations, one of these being on each eyelid. There were numerous freckle-like pigment spots. All the lids were everted, and there was an epitheliomatous mass on each. In the right eye, there was thickening and redness of the tarsal conjunctivæ, bulbar injection, diffuse opacity of the cornea without loss of lustre, vascularization of the corneal periphery, and two small infiltrates at the nasal margin of the cornea. The conditions in the left eye were similar, but with, in addition, a pigmented mass at the temporal side extending from the root of the iris to the back of the cornea, and measuring 5 by 3mm.

CASE II.—Brother of the last, also aged 8. The general condition was similar. In the right eye, there was, at the temporal margin of the cornea, a small yellowish-white elevation, measuring about 4 by 3mm., situated in the epithelium. The left eye presented a papillomatous mass at the corneal margin.

A. J. BALLANTYNE.

(2) The first case described by **Hiram Woods** was one of chronic uveitis which, after two years, was traced to alveolar absorption, by which is meant apparently septic absorption from a root abscess and pyorrhoea. The extraction of a crowned dead molar, having a drop or two of pus at its apex, was followed by sudden exacerbation of inflammatory symptoms, giving way to consistent although slow recovery, with practically full vision.

The second case was one of paracentral colour scotoma in a patient with symptoms pointing to intestinal auto-intoxication arising from obstruction of the transverse colon near the splenic flexure. Removal of the obstructing band of fat and some unexpected gall stones was followed by prompt improvement. A relapse of symptoms occurred eleven years later, but this gave way to purgation, regulation of diet, and rest.

The third case was one of shifting toxic scotomata, which

seemed to be causally related to the use of alcohol and gastro-intestinal disturbances. The areas of dim vision and blindness changed in shape, size, and position. The patient was eventually cured of his trouble by abstinence from alcohol and tobacco, regulation of diet, and the daily use of purgative water.

J. JAMESON EVANS.

(3) **Brawley** reviews the relations of metabolic disturbances to diseases of the eyes, and particularly to intra-ocular disease, and reports cases of central scotoma due to gastro-intestinal disturbances; iritis due to intestinal toxaemia; macular choroido-retinitis due to catarrhal gastritis with post-scarlatinal nephritis; choroidal exudates and vitreous opacities associated with dyspepsia nervosa, catarrhal colitis, hyper-thyroidism and menstrual irregularities; uveitis, secondary glaucoma, choroido-retinal atrophy, papillitis, with acidosis; vitreous opacities with catarrhal gastritis and acidosis. In all cases the ocular lesions were relieved by treatment directed to the primary systemic disease, along with the usual local treatment applied to the eyes. Brawley remarks that "examination of these unusual eye cases includes a thorough study of the accessory nasal sinuses, tonsils, teeth, urinary tract, glandular system, etc., in order to exclude all possible sources of toxaemia."

J. JAMESON EVANS.

(4) This paper by **Bulson** is intended to be a digest of the views of various authorities on the early diagnostic retinal signs of nephritis and arterio-sclerosis, but he confines himself, in the main, to a consideration of the fundus lesions in acute and chronic Bright's disease.

In his preliminary remarks there is a good deal of sound common sense. He states that there is no occasion to separate chronic Bright's disease into distinct types, since neither the parenchymatous nor the interstitial form ever exists alone. Neither is there occasion to separate the fundus lesions of chronic Bright's disease from those of general arterio-sclerosis, since chronic nephritis should not be considered as a disease of the kidneys alone, not even primarily, but as a disease of the cardio-vascular system.

Whatever the form of Bright's disease, the ophthalmoscopic picture is essentially the same in all types of chronic nephritis, and without the arterio-sclerotic changes it is the same in acute nephritis. The fundus changes are very largely a question of degree or stage rather than distinctive types. All are evidence of the action of a toxin in the blood-stream which induces inflammation of the inner layers of the retina (and, as a complication, of the choroid also) and subsequently vascular degeneration.

He discusses the question of period of onset, sex, the frequency of retinitis in pregnancy and the time of onset, the retinitis of the post-exanthematous nephritis, and the differential diagnosis of

albuminuric retinitis from similar lesions due to syphilis, intracranial diseases, etc.

High blood-pressure must be considered a part of the clinical picture, since it is invariably associated with the fundus lesions of chronic Bright's disease or general arterio-sclerosis. The presence of the fundus lesions without albuminuria is always associated with increased arterial tension and cardio-vascular changes which indicate approaching kidney degeneration, and are valuable indications for early treatment.

"The early fundus lesions consist in almost indistinguishable small white or milky-coloured dots of exudation, few or perhaps many in number, which appear in the neighbourhood of the disc and most frequently in the macular region; the haziness and often delicate hyperaemia of the disc; isolated faintly milky-coloured areas in the retina due to oedema; the beaded appearance of some of the larger arteries from thickening of the walls, and distension of the smaller terminal veins; and, as important as any indication, the appearance of relative scotomata, more often central, either with or without visible retinal alteration. Any two or all of these lesions may co-exist, and any one or all may exist with but little or no alteration in the vision as detected by the patient. Usually, however, the patient sufters from slight fogginess of vision, or mild retinal irritation, the latter manifested by slight photophobia or retinal fatigue which prompts him to seek relief, or, as is frequently the case, the condition of the retina and its effect on vision are discovered by accident, as in the routine examination for glasses."

The bending of the veins and slight distal dilatation at the points where they are crossed by arteries, loss of arterial transparency and broadening of the light reflex, hollowing of the optic disc, not amounting to cupping, and obscuring of the small vessels on the disc by incipient œdema may also be noted, and so also may white lines along the arteries and corkscrew twigs. As these changes may disappear under favourable conditions, their early recognition and the establishment of appropriate treatment are of considerable importance. The latter changes are so well-known and recognized that it is not necessary to refer to them, but numerous anomalous cases reported in current literature are referred to and a bibliography is appended.

J. JAMESON EVANS.

(5) **Black** classifies the ocular disturbances which result from dental lesions into two groups.—(1) Reflex neuroses presenting as sensory, vasomotor, or muscular disorders; (2) inflammation of the various tissues of the eye due to infections.

The former are practically always due to irritation of the vital pulp of a tooth, although an occasional case may be due to an impacted tooth; the latter are practically always due to an infection involving

the peridental membrane, either in the form of an alveolar abscess at the root or a pus pocket alongside the root. As probably not less than 50 per cent. of all persons having teeth present one of these conditions, the mouth is doubtless the most frequent offender in cases of secondary eye lesions. As some mouth affections are not apparent to ordinary inspections, it is necessary to have a radiographic search made in any doubtful case. All teeth which have been crowned, or which are discoloured, should be suspected of having chronic abscesses and call for special investigation. Pus pockets alongside the roots may or may not be discovered by the radiograph. These pockets frequently involve but one side of the root, but they are always open at the neck of the tooth, and an instrument with a thin blade may be passed into them. Pus may be often forced out by pressure on the gum, and digital examination may reveal alveolar absorption about the affected roots. The teeth involved may be loose or they may remain firm, even although deep pockets are present at one side or about one root of a multi-rooted tooth. The general appearance of the soft tissues is not a safe guide, as the outer surface of the gums may appear normal, while the surface adjacent to the teeth may be much inflamed.

Since some 25 per cent. of all people suffer from chronic alveolar abscesses, and another 25 per cent. from chronic suppurations beginning at the gingival margins, it must be recognized that the natural resistance of most persons appears to be sufficient to protect them against such foci, but in the event of the appearance of ocular trouble which can be regarded as of septic origin, it is the duty of the oculist to ascertain, by every method known to science, the exact condition of the mouth. From the dentist's side, it is more important that he should keep mouths free from infection rather than be able to find such foci after their presence has been heralded by secondary manifestations.

J. JAMESON EVANS.

(6) **Haskin** read this paper before the Section of Ophthalmology of the New York Academy of Medicine. He points out that the majority of American oculists seem to have failed to recognize the relationship of septic dental infections to certain chronic eye conditions, in spite of the attention that has been drawn to this connection in recent English literature. He quotes the statistics of Kenneth Campbell, W. Lang, B. T. Lang, Yeld, and Harrison Butler in support of his views. He states that the body suffers in two ways from the presence of septic foci :—(1) from the constant absorption of the toxins that are produced during the growth of many bacteria, and (2) from the actual invasion of the blood-stream by the bacteria themselves, in which case localized manifestations soon develop. In over 90 per cent. of septic dental foci the streptococcus viridans, which has been proved by inoculation experiments on rabbits to be

virulent, has been identified. Although positive blood cultures have seldom been reported in these cases, it is quite probable that many more would be found if daily cultures were taken over a period of several days. Hecker published some observations on the blood counts in pyorrhoea alveolaris in which he had found a considerable amount of leucocytosis (*Amer. Jl. of the Med. Sciences*, June, 1915). Haskin gives notes of seven cases in which attention to dental treatment was successful in the cure of cyclitis, iritis, keratitis, and conjunctivitis, where the usual treatment for those affections had met with no success.

The diagnosis of dental sepsis is not always easy, and an X-ray photograph will often reveal conditions that were previously unsuspected. Careful inspection will show minute fistulous tracks round the neck of an affected tooth. As pain is generally absent, it is difficult to persuade the patient to submit to the radical dental treatment necessary. He says that he has never seen a gold crown or fixed bridge that was not the source of trouble sooner or later, and from the examination of sections of teeth he has come to the conclusion that it is impossible to fill root canals, so as to render them sound. No such dental work, therefore, should be allowed to remain in the mouth.

Haskin says nothing about vaccine treatment, although another article in the same number of this Journal by Dr. Medalia (of Boston) claims very successful results for autogenous vaccines.

E. E. H.

(7) This paper by **Krauss** and **Brown** discusses a number of cases of optic atrophy, which, in the opinion of the authors, are of unusual interest.

The first was unilateral and in a child; it was considered to have been due to syphilis by virtue both of the results of a Wassermann reaction and by those of treatment. In the second case, the patient, who was *absolutely blind*, was enabled to see large objects by anti-syphilitic treatment; neo-salvarsan was used. The third case defied every attempt to ascertain its aetiology. In the next patient, provisional diagnosis was made of hæmorrhage into the occipital lobe; the case was ended by the patient drowning himself. In the fifth case a benign intra-cranial neoplasm was arraigned as the cause; the patient was greatly benefited by treatment with iodine. The last case was one of optic atrophy, incidental to disease or to faulty development of the pituitary body.

The interesting feature of the communication is the determination which pervades it to get, if possible, at the cause of each individual case, and thus to establish a rational basis for treatment. It is open to question whether it is even now sufficiently widely recognized that to "tag" a name on to a condition is not the whole duty of an ophthalmic surgeon. Efforts such as that represented by the

present paper are becoming more and more frequent, and are of great value to the future of ophthalmology. There can be no doubt that a very large amount of work along the same lines is being carried on by ophthalmologists all over the world, but the published output of carefully recorded cases, such as those now under review, is still sufficiently limited to make every thoughtful contribution of the kind of definite value.

R. H. ELLIOT.

(8) **Cohen** records two cases of metastatic panophthalmitis, occurring in his practice in a period of about four months. The first was bilateral, and associated with an attack of lobar pneumonia, which proved fatal. A double salpingectomy had been performed six weeks before the commencement of the lung symptoms. The second case was in association with lobar pneumonia, and it, too, proved fatal; there was a history of attempts to arrest a supposed gestation. The bacteriological findings, etc., are discussed, and a list is given of the previous cases in which metastatic panophthalmitis has been observed to complicate pulmonary affections.

R. H. ELLIOT.

(9) **Blum** reports several instances of keratitis due to reflex disturbance produced by irritation of the branches of the trigeminus through dental caries. The cases include interstitial keratitis, central corneal ulcers, dendriform ulcers, recurrent herpetic ulcers, ulcers of the "rosacea" type, deep keratitis, and one of corneal abscess. A marked loss of sensibility of the cornea was a striking feature in every case, and whenever the patient submitted to the requisite dental treatment, prompt relief from the corneal trouble was secured.

J. JAMESON EVANS.

(10) **Veasey** reports two cases of paralysis of accommodation, apparently related to infection from septic tonsils. In one case, the paralysis was monocular and the tonsils were deeply buried and adherent, with large crypts filled with cheesy débris, and a number of large yellowish spots beneath the surface. Six days after tonsillectomy the accommodation was entirely restored. In the second case, the accommodative paralysis was binocular. The tonsils were enlarged, subacutely inflamed, with pus and débris exuding from the follicles. The tonsils were enucleated, and a concealed abscess, containing staphylococci and streptococci, was revealed and emptied on the right side. Recovery of accommodation was complete three days after the operation.

J. JAMESON EVANS.

(11) **Standish** calls attention to the danger incurred by the indiscriminate use of thyroid products for the reduction of body weight. He has been able to find only eight cases in literature of retrobulbar neuritis with central scotoma which have been attributed

to the abuse of thyroid extracts; he suggests that some of those which occur may be overlooked, as he is able to add three cases of his own, in each of which the discontinuance of the drug was followed by recovery of vision. The most striking thing in this short series of cases is the wide difference in the toleration of the drug. One patient had taken the thyroidin in large doses for many years, whilst another had taken an unknown amount for only three days. He makes his report with due reserve, but thinks that attention should be directed to the indiscriminate sale of proprietary drugs containing thyroid extract.

R. H. ELLIOT.

(12) In this paper, read before the Chicago Ophthalmological Society, **Beck** emphasizes the need for co-operation between ophthalmologists and other specialists, more particularly those engaged in oto-laryngology. He gives, in considerable detail, the notes of a number of cases, some of which are of unusual interest. We may be permitted to refer to two divisions of his subject. That which deals with the connection between visual disturbances and labyrinth trouble, deserves careful study as it has a practical bearing on our everyday work. The same may be said, too, of the discussion of a case of recurrent unilateral iritis, which had been under the care of many distinguished ophthalmic surgeons, and had been treated for many probable sources of infection in turn; it seems strange that the possibility of tubercle as an aetiologic factor finds no mention in the record. The paper is admittedly a surgical miscellany, but it is worth reading nevertheless.

R. H. ELLIOT.

(13) Four cases of anterior poliomyelitis presenting ocular complications are recorded by **Posey** and **Swindells**.

The first case showed atrophy of the optic nerves and paralysis of the left abducens. The optic discs were greyish-white, the outlines were sharply defined, and the retinal vessels were markedly reduced in size. The atrophy was supposed to have been due to a meningitis, although it did not present the usual appearances seen in descending neuritis associated with meningitis, and it may therefore have been of toxaemic origin. Weisenburg, commenting on this case, was of opinion that it was either the result of a toxaemia or a nuclear lesion—say, of the external geniculate bodies. He doubted whether any of the palsies of infantile paralysis are of meningeal origin, since he had never observed an anterior or a posterior root lesion, or a cranial nerve lesion, due to meningitis.

The second case showed paralysis of the left sixth and seventh nerves with no other ocular lesion; the third case showed ptosis only; and the fourth, complete external ophthalmoplegia with healthy eyes and normal vision.

J. JAMESON EVANS.

(14) Although in the title of this short account of a case of double cyclitis, it is inferred that the cyclitis *followed* the plague, it is stated in the text that the patient, a worker at the Marseilles docks, was suddenly attacked with plague (the pustule being in the axilla), and that at the same time he had diminution of vision and pain. He was taken to the Hospital de la Conception, where he remained three weeks, and came out of it blind, though cured of the plague. With the right eye he had perception of light only ; with the left, no vision.

ERNEST THOMSON.

(15) **Wyler's** patient was a girl, aged 5 years, ill for four days with a mild attack of varicella. On the second day of the eruption, the right eye became painful and photophobic. When seen, there were slight swelling of the upper lid, and moderate conjunctival and ciliary injection. In the centre of the cornea was a perfectly circular, punched-out ulcer, measuring about 2 mm. in diameter, which stained deeply with fluorescein. The pupil reacted sluggishly. Under treatment the ulcer healed slowly in two weeks, leaving a nebula ; vision reduced to 6/36.

Wyler believes that the ulcer was the result of the eruption of a vesicle on the cornea; its appearance coincided with the skin eruption ; it was larger than a herpetic vesicle, and healing was slower than in ordinary keratitis. He has found only one similar case on record. This was reported by Terson (*La Clin. Ophtal.*, June 1, 1914), and closely resembled in all respects Wyler's case. It occurred in a girl, aged 18 years, and was attributed by Terson to a ruptured vesicle on the cornea.

J. B. LAWFORD.

(16) **Demaria** records two interesting examples of general uveitis in subjects affected with vitiligo. The ocular disease was so far advanced in both as to render the patients almost blind. The first case occurred in a boy of 18, in whom the Wassermann and von Pirquet reactions were both negative. A diagnostic injection of tuberculin in this case caused a marked general reaction, as well as a focal reaction, in the eyes.

The second case was in a woman of 45, in whom the tuberculin reactions were negative, but who gave a positive Wassermann reaction.

In the first case an iridectomy was performed on each eye, without benefit, nor did the ocular condition respond to a course of injections of tuberculin. At the present time bare perception of light is present.

The second case had also had iridectomy performed previously to coming under Demaria's care; at the present time the eyes are practically blind, and the tension is low.

Demaria discusses shortly the cases of ocular affections occurring

in patients with vitiligo, which have been reported by Gilbert, Erdmann, and Komoto.

R. R. JAMES.

II.—PATHOLOGICAL ANATOMY

(1) **Kirsch, R. (Berlin).—An anatomical examination of a case of cilium in the anterior chamber.** (Anatomische Untersuchung eines Falles von Cilie in der Vorderkammer.) *Zeitschr. f. Augenheilk.*, Bd. XXXII, 1914, S. 426.

(2) **Lüdeke, Fritz (Rostock).—The anatomy of colobomata of the optic nerve entrance.** (Zur Anatomie der Kolobome am Sehnerveneintritt.) *Klin. Monatsbl. f. Augenheilk.*, April-May, 1915.

(3) **Uhthoff, W. (Breslau).—Bilateral symmetrical degeneration of the cornea with deposit of uric acid and acid urate of soda in otherwise normal eyes and with good general health.** (Doppelseitige symmetrische Degeneration der Kornea mit Ablagerung von Harnsäure und saurem harnsaurem Natron bei sonst normaler Beschaffenheit der Augen und gutem Allgemeinbefinden.) *Klin. Monatsbl. f. Augenheilk.*, April-May, 1915.

(4) **Uhthoff, W. (Breslau).—A case of bilateral, central, punctate subepithelial keratitis (Nodular keratitis—Grœnouw) with anatomical examination.** (Ein Fall von doppelseitiger zentraler, punktförmiger, subepithelialer Keratitis ("Knötchenförmiger Keratitis" Grœnouw) mit anatomischen Befunde.) *Klin. Monatsbl. f. Augenheilk.*, April-May, 1915.

(5) **Neeper, E. R. (Colorado Springs).—Carcinoma, apparently primary, arising from the ciliary processes.** *Trans. Colorado Ophthal. Congr.*, July 22 and 23, 1915, p. 6.

(6) **Lane, Francis (Chicago).—Peripheral annular infiltrate of the cornea following a scleral perforation.** *Trans. Colorado Ophthal. Congr.*, July, 1915.

(7) **Clegg, J. Gray (Manchester).—A case of sarcoma of the socket.** *Trans. Ophthal. Soc. U.K.*, Vol. XXXV, 1915, p. 197.

(8) **Re, Francesco (Palermo).—A note on the pathological anatomy of Parinaud's conjunctivitis.** (Note di anatomia patalogica sulla congiuntivite di Parinaud.) *Arch. di Ottal.*, January, 1916.

(9) **Magitot, A. (Paris).—Pigmented nævus of the choroid.** (Nævus pigmenté de la choroïde.) *Ann. d'Ocul.*, March, 1916.

(10) **Alt, Adolf (St. Louis).—Bone tissue in the optic nerve, pia mater and dura mater sheaths.** *Amer. Jl. of Ophthal.*, March, 1916.

(11) **Alt, Adolf (St. Louis).—A case of implantation cyst of the iris.** *Amer. Jl. of Ophthal.*, May, 1916.

(12) **Brown, H. H. (Chicago).—Bony tumour of the vitreous chamber springing from the ciliary body.** *Ophthalmology*, October, 1916.

(13) **Hird, R. Beatson (Birmingham).—Notes on a case of tumour in the retina (massive exudation).** *Trans. Ophthal. Soc. U.K.*, Vol. XXXVI (1916), p. 345.

(14) **Greeves, R. Affleck (London).—Some observations on four trephined eyes examined microscopically** *Trans. Ophthal. Soc. U.K.*, Vol. XXXVI (1916), p. 445.

(1) **Kirsch** gives details of the histology of an eye which was enucleated after perforation by an iron splinter removed with the giant magnet. A cilium was present in the anterior chamber, but it seems to have had nothing to do with the chronic irido-cyclitis which destroyed the eye. The microscopic details are made clear by a good coloured plate.

The author points out that these cases are not uncommon. Several have been recorded, and many more have not been published. Generally, there has been a perforating wound, but in the case recorded its site could not be discovered. Cilia may be retained for years in the anterior chamber and cause no irritation. They gradually become altered by the action of the aqueous, but it is not certain that they are ever completely absorbed.

T. HARRISON BUTLER.

(2) After reviewing the literature bearing on the pathological anatomy of colobomata of the optic nerve entrance, including crater-like holes in the disc, and the so-called conus at the lower border of the disc, **Lüdeke** describes and figures the microscopic characters of a case in which there was bilateral coloboma of the iris and choroid, associated with coloboma of the optic nerve entrance. He concludes that this case is an example of a true coloboma of the nerve head, due to the intrusion of mesodermal elements into the optic nerve at the ocular cleft.

A. J. BALLANTYNE.

(3) **Uhthoff's** patient, a man of 53 years, began to suffer from inflammatory attacks, first in one eye and then in the other, at about the age of 20. At first there were intervals of about a week between the attacks, but latterly the condition had been practically always present. When first seen, the condition was diagnosed as episcleritis. Twelve years later, both eyes showed a broad greyish-

yellow opacity at the margin of the cornea, the surface being of normal smoothness. It was then looked upon as a fatty degeneration without ulceration. He was seen for the third time four years later. The corneal condition had advanced. Only the central and supracentral part of the cornea was clear, the rest being the seat of dense yellow opacity. The surface was still smooth. The edges of the opacity were fairly sharp. With the *loupe* there were seen to be in the midst of the opacity scattered glistening deposits suggestive of cholesterin masses. While he was under prolonged clinical observation, there were repeated inflammatory attacks, but there was no change in the cornea. General investigation showed no tubercle, no gout, no heart or kidney affection. Wassermann was negative. There were no intra-ocular changes.

Microscopic examination of excised portions of the affected cornea showed the presence of many acicular and brush-like crystals of acid sodium urate, also scattered deposits of a brown colour (sodium urate or uric acid), which may have been responsible for the glistening spots in the corneal opacity.

Treatment of various kinds was tried, but without result. Intravenous injection of thorium 'X,' which is supposed to convert uric acid into a more soluble form, was without effect.

A. J. BALLANTYNE.

(4) **Uhthoff** describes the case of a young man, 20 years of age, who had been known to suffer from opacity of the corneæ since the age of 15. There were changes at the centre of each cornea, consisting of a cluster of pearly-grey spots under the epithelium, some of them confluent. There were no inflammatory symptoms. Scraping of the surface layers was carried out several times, but the opacities were not entirely removed, and the condition recurred. The superficial part of the cornea was then removed with a knife and examined in sections. These showed here and there defects in Bowman's membrane, with groups of epithelial cells penetrating downwards through the gaps. In some places there were masses of hyaline material between the corneal lamellæ and not far below the epithelium, sometimes indeed penetrating through Bowman's membrane. Some of these masses were elongated and linear in form. Before the last operation some of the visible opacities had been assuming a linear form, giving a certain resemblance to lattice-shaped opacity. This fact supports the view that nodular opacities and lattice-shaped opacities are not to be sharply differentiated, and that the former may pass into the latter in their later stages. The two conditions also resemble each other in their hereditary and familial character. A. J. BALLANTYNE.

(5) In view of the rarity of primary carcinoma of the ciliary body, the case by **Neeper** may be given at some little length:

The patient, aged 71 years, had noticed a dark object before the

right eye for a month or more. R.V.=P.L. in temporal field. The temporal 3/5 of the right sclera could not be transilluminated. Tension normal. There was an intra-ocular projection towards the centre of the vitreous, its base occupying the space between axis 105° and axis 150°. The retina appeared as if stretched more or less tightly over a firm object. The eye was kept under observation. It became slightly sensitive and injected. Six weeks after it was first seen, the lens had become cataractous, the iris was distended forward, and there were degenerative changes of the latter towards its periphery. The eye gradually became more inflamed and painful during the following two weeks, at the end of which time it was enucleated. One hundred and fifty-seven days after the operation, a small, olive-shaped tumour was found beneath the abdominal skin near the end of the tenth rib. Since that time many similar growths have appeared upon the trunk, and one, larger than the others, on the neck in the carotid region.

"The early demise of the patient is expected, and an autopsy will probably be had."

George S. Dixon made the following report on the growth:—

The tumour extended from the ciliary region backwards for a distance of 13 mm., where it ended abruptly. The anterior portion was in contact with the lens, and the posterior free.

It encroached on the vitreous towards the median line, a distance of 10 mm. Its colour was grey near the sclera, shading off into brown, and almost black towards the median line of the globe.

"The cell is the epithelium of the ciliary processes, from which the tumour seems to arise, and they infiltrate the pars at the base to the ora, but do not follow the choroid, which is atrophic. The arrangement of the stroma is alveolar, and it carries the blood vessels which all have good walls. The growth is particularly vascular towards its inner surface or border, and a considerable portion of this part of the growth has undergone cell necrosis. There is a little pigment in this part of the tumour. The iris has the appearance of simple atrophy. Diagnosis: Carcinoma arising from the ciliary processes."

S. S.

(6) **Lane** presents an elaborate illustrated pathological report upon an eye removed from a boy, aged 11 years, who had been injured by a spring gun. When first seen, twenty-four hours after the accident, there was a perforation, about 2 mm. wide, through the sclera, lying 5 mm. from the sclero-corneal junction. The cornea, otherwise uniformly cloudy, was encircled by a gray ring, 1 mm. broad, the peripheral border of which was situated 1 mm. to 2 mm. from the limbus. There was hypopyon, and an exudation in the pupil. Tension sub-normal. No red reflex from the fundus.

There was an unhealed perforating wound of the sclera lying

some 6 mm. behind the corneo-scleral border on the nasal side in the horizontal meridian of the eyeball. As to the cornea, there was total exfoliation of the epithelium. At a distance of about 1·5 mm. to 2 mm. from the corneal margin the lamellæ were spaced by widened lacunæ, closely packed with polynuclear leucocytes. On the inner edge—*i.e.*, centrally—this disappeared gradually, becoming wedge-shaped, with the apex reaching almost to the centre of the cornea in the middle layers. Descemet's membrane, from which every trace of endothelium had vanished, remained intact. The anterior chamber was filled with a fine granular coagulum enmeshed at the angles with a delicate fibrinous network. Numerous pus cells in the region of the filtration angle. Free pigment granules were plentiful. Purulent iritis and necrosis. Cyclitis. The processes of the ciliary body were intensely congested, matted, and densely infiltrated with polynuclear leucocytes, and much cellular exudation had been poured out into the posterior chamber, the canal of Petit, and the vitreous. Extensive necrosis of retina. The anterior and posterior vitreous were permeated with pus cells, and a large aggregation of polynuclear leucocytes lay behind the sclera in the region of the optic nerve.

Pneumococci were found in the anterior part of the vitreous. No micro-organisms elsewhere. S. S.

(7) **Clegg** found a large pedunculated granular red mass growing from the outer part of the socket left by removal of an eye, for some cause unstated. The growth was excised. Two pathologists regarded it as non-malignant. Some three months later, however, there was a recurrence. On this occasion other skilled pathologists reported that the growth was a sarcoma. In consequence of this view, the contents of the orbit were exenterated. S. S.

(8) **Francesco Re** has watched and examined a case of Parinaud's conjunctivitis, and concludes that Wessely was right in supposing that the disease is tuberculous in nature.

Re excised a large piece of conjunctiva from the affected area and submitted it to microscopical examination; he found the covering epithelium only in certain points, sometimes swollen and vacuolated, and in other parts replaced by granulation tissue with numerous large capillaries.

The papillæ were deformed, the derma was swollen by separation of connective tissue bundles and by infiltration with lymphoid elements. In the deeper regions of the mucosa were seen "nests" resembling tubercles. They had surrounding them large capillaries over-filled with blood, and were made up of epithelioid elements, of giant cells, and lymphoid elements. In these, in which the new vessels were limited to the periphery, the giant cell was placed eccentrically, and was surrounded by rarified elements which were evidently undergoing

karyolysis. In the neighbourhood of the giant cells the tissue was seen clearly to be undergoing necrosis.

Re imagines that the exciting bacillus had been attenuated by passage through some animal. H. GRIMSDALE.

(9) **A. Magitot** gives a description of a pigmented nævus of the choroid, found in an eye enucleated to allow of the removal of an epithelioma of the ethmoidal sinus. The eye was examined by the author before the operation, and nothing abnormal was detected. The tumour was found while sections were being cut with a view to obtaining specimens of the normal retina. It measured 1·5 mm. by 0·5 mm., and was situated midway between the equator and the papilla. The following appearances were seen in sections stained by the ordinary methods: (*a*) the tumour was very pigmented; (*b*) it was disposed longitudinally, and ended gradually; (*c*) it extended outwards to the sclera, and had invaded the supra-choroidal space; (*d*) it extended inwards to the chorio-capillaris, but did not pass it. The pigmented retinal epithelium was absolutely intact, but pushed inwards by the tumour so as to cause a slight projection of the corresponding retina; (*e*) it was traversed by the choroidal arteries and veins, but there was no augmentation in the number of these, and their diameter appeared diminished; (*f*) the corresponding retina was raised, not detached, and there was no evidence of any abnormality or disease in it. Decolourized specimens showed that the tumour consisted centrally of large polygonal cells, epithelioid in appearance, and peripherally of fusiform cells of definitely connective tissue aspect. Both kinds of cell were loaded with pigment, and were of adult type. The vessels of the tumour had normal endothelium, and it was in their neighbourhood that the cells took on the fusiform type. The walls of the choroidal arteries consisted of endothelium, surrounded by the fusiform cells, the muscular and elastic tissues being absent. The transition between the two types of cells was gradual. There was nothing in the tumour to suggest malignancy. The author considers that the cells of the tumour presented all the appearance of chromatophores in their fusiform aspect, and that the remarkable thing about them was their transformation into polygonal epithelioid cells. He calls attention to their relation to the choroidal arteries, as supporting their connective tissue origin, and also as being suggestive of a neoplasm, and resembling sarcoma. R. J. COULTER.

(10) The optic nerves and posterior parts of the eyeballs of a medical man, aged 32 years, dead of septicaemia, have been examined by **Alt**. The most interesting point in the case is the finding of bone in one optic nerve. The post-mortem diagnosis had been "septicaemia, acute endocarditis, chronic aortic and mitral insufficiency, lobar pneumonia, chronic interstitial nephritis, infarct of spleen."

During life, Ewing had found marked neuroretinitis (hæmorrhagic) in both eyes. Post-mortem, the general appearance of the right optic nerve and papilla pointed to œdema with low grade neuritis. Behind the entrance of the central artery many amyloid bodies were found lying in the intervaginal space or the adjacent dural sheath, and rarely in the pia. Though usually associated with optic atrophy, there was no atrophy in the present case. The amyloid bodies lay outside the nerve tissue. They seemed to derive their origin from a metamorphosis of connective tissue fibres rather than from neuroglia. In a number of transverse sections of the optic nerve, behind the entrance of the central artery, there was found a small irregularly-shaped body composed of bone tissue. Its layers were arranged around a small vessel. Thus this bone tissue appeared to have arisen from the vessel walls. It may have started from an amyloid degeneration of the blood-vessel walls, followed by infiltration with lime and transformation into bone. "The likeness to so-called colloid bodies of the lamina vitrea of the choroid which have changed into bone tissue is apparent." This probability is strengthened by the finding of a larger bone plate in the inner layers of the dural sheath and a smaller one in the pial sheath. While bone formation in the dural sheath has been found once previously, according to Alt, the occurrence of bone in the optic nerve is a unique observation. The author does not venture to draw any conclusion as to a causal relation between the changes in the optic nerve and the chronic septicaemia to which the patient had succumbed.

In the left optic nerve, which presented evidence of a further-progressed neuritis, neither amyloid bodies nor bone tissue was found. There was a large thrombus in the central artery where it entered the nerve. It was infected by streptococci.

ERNEST THOMSON.

(12) The patient here referred to was 18 years of age when first seen by **Brown**. There was a history of attacks of inflammation of the right eye at the age of four months, at seven or eight months, and at five years. On each occasion one or more specialists had made a diagnosis of glioma of the retina and advised enucleation. When seen by the author, the eye was inflamed and very painful. There was corneal opacity, but a yellowish reflex from the pupil was visible. Vision was reduced to light-perception. The eye was enucleated, and the pathological report described a large pale mass, consisting of fibrous tissue containing bone, springing from the ciliary body. Both from the clinical history and from the pathological point of view, the condition is considered to have been fœtal in origin. A. J. BALLANTYNE.

(13) In the left eye of a female patient, aged 64 years, **Hird** found extensive ophthalmoscopic changes, especially in the macular region.

V.=hand movements. Slight divergence. No rise in tension. Under the impression that he had to deal with a new growth, and, after consultation, the eye was removed. The opinion was expressed by a pathologist that "it was a form of malignant growth springing from the retinal pigment cells rather of a sarcomatous nature." A sub-committee of the Ophthalmological Society, however, after examining sections, reported that "the case belongs to the type which was described by the late Mr. George Coats as 'A Form of Retinal Disease with Massive Exudation.'" S. S.

(14) **Greeves** showed microscopical specimens taken from four glaucomatous eyes in which the Elliot operation had failed to give permanent relief to the increase of intra-ocular pressure, the cause being in each case prolapse of the ciliary processes into the wound made by the trephine. In two of the specimens the wound was completely lined with uveal tissue, and no filtration was taking place. In the third, some drainage was going on, as shown by the presence of oedematous subconjunctival tissue. In the fourth (in which iridectomy was not performed), there was not even a bulging of tissue through the scleral aperture, and the condition was further complicated by a portion of the scleral disc having been left behind. The patients ranged in age from 30 to 65 years. The trephine was 3.5 mm. in diameter in three operations, and 4 mm. in the fourth. In no instance did the wound involve the true cornea for any distance. Greeves enquries whether the far-back position of the wound might not be the cause of the prolapse of the ciliary processes. A section through a normal eye, across one of the ciliary processes, suggests that prolapse might be possible, even if the aperture were placed well in the cornea. But in no instance could a ciliary process prolapse forward beyond the level of the zonula unless the corresponding fibres of that structure have been ruptured, inasmuch as the equatorial zonular fibres are attached to the ciliary processes. Greeves suggests that the zonular fibres may be ruptured during the operation by a sudden bulging forward of part of the ciliary body, and so allow the ciliary processes to come forward as well. The moral of these speculations appears to be the great importance of placing the posterior limit of the trephine wound so as to lie well in front of the anterior limit of the ciliary body. It has been shown by Le Magourou (*Arch. d'Ophtal.*, February, 1914) by measurement that the average distance at the upper part of the anterior chamber from the limbus to the extreme angle of the chamber is 1.75 mm. (distance varies from 1.25 mm. to 2.25 mm.). In the light of these measurements Greeves thinks that a 1.5 mm. trephine is safer to use than one of a greater diameter. Further: that if the cornea be stripped superficially, and the trephine placed as far forwards as possible, then the resulting wound must be well in front of the ciliary body. There can be no objection to placing

the wound in the cornea on the ground that the formation of new organized tissue is more likely to follow this procedure. Pathological experience shows that the cornea is notoriously inert in producing new fibrous tissue in any quantity. The tissue which rapidly fills scleral wounds with scar tissue is produced from the episclera and the ciliary body and the choroid. The sections described by Greeves do not bear out Holth's view, viz., that in order to ensure drainage, uveal tissue must be included in a trephine wound. S. S.

III.—OPERATIONS

(*Third Notice*)

3.—Conjunctivo-Keratoplasty

(1) **Knapp, Arnold (New York).—The operative treatment of partial staphyloma of the cornea and of fistula of the cornea, with a conjunctival flap, conjunctivo-keratoplasty (Kuhnt).** *Trans. Amer. Ophthal. Soc.*, Vol. XIV, Part ii, 1916, p. 466, and *Arch. of Ophthal.*, Vol. XLV, No. 4.

(1) **Knapp** deals with the difficult subject of the treatment of partial staphyloma of the cornea, complicated with glaucoma and attacks of irido-cyclitis, and places on record the notes of three cases of his own, in two of which good results were obtained. He says that "the only method of treatment which offers some prospect of success consists in excision of the staphylomatous portion of the cornea, in release of the adherent iris with iridectomy, and in covering the defect with a double pedunculated conjunctival flap as recommended by Kuhnt." He insists on the necessity of performing the iridectomy "early enough," and believes "that it should be done just as soon as the inflammatory conditions in the cornea permit, and that it is a mistake to wait until the intra-ocular tension is increased."

No mention is made of the value of trephining in these cases, as a method of permanently reducing the tension of the eyes. This latter method has given excellent results in the hands of many surgeons, and is highly spoken of by Major Kirkpatrick of the Government Ophthalmic Hospital at Madras, in the current number of the *Reports* of that hospital. R. H. ELLIOT.

4.—Operations upon the Eyelids

(1) **Kuhnt, H. (Bonn).—Upon the treatment of epiphora caused by eversion or commencing ectropion of the lower lid. (Zur Bekämpfung der Epiphora infolge von Eversio oder beginnenden Ektropium des unteren Lides.)** *Zeitschr. f. Augenheilk.*, March-April, 1915.

(2) **Kuhnt, H. (Bonn)—A contribution to the cure of severe traumatic cicatricial colobomatous ectropion of the lids which is adherent to the bone. (Ein Beitrag zur Beseitigung der hochgradigen traumatischen knochenadhärenten Narbenkolobom-Ektropien der Lider.)** *Zeitschr. f. Augenheilk.*, March-April, 1915.

(3) **Shine, Francis W. (New York).—The Motais operation for ptosis.** *Trans. Amer. Ophthal. Soc.*, Vol. XIV, Part ii, 1916, p. 733.

(1) **Kuhnt** is opposed to the very common practice of slitting up the canaliculus of every person who complains of epiphora.

Quite frequently it is found that the lacrymal passages are fully patent and normal in every respect. The operation is a failure because it does not in any way affect the cause of the disease. This, in the class of case under consideration, is the failure of the lower lid to maintain its apposition to the globe. The punctum therefore does not come into contact with the fluid it should carry away.

Therapeutic measures must be directed towards the restoration of normal drainage by removing those causes which hinder it.

Three large groups of disease must be considered: 1. there are anatomical anomalies in the lacrymal passages; 2. the lids are in a faulty position; or 3. there are defects in the innervation of the orbicularis muscle.

The first group comprises obstructions in any part of the lacrymal channels.

The most frequent anomaly in the second group is very slight eversion of the lower lid, but occasionally the same result is caused by the opposite deformity, inversion of the lid, often due to spasm.

The third group contains cases of paresis of the orbicularis, and of wasting of the tissues by age and other causes.

By far the commonest cause of epiphora is some form of obstruction in the lacrymal passages. It is therefore essential to commence with *lavage* of the duct. If the fluid pass easily to the nose, a pathological block can be excluded.

Stenosis of the puncta can be cured by dilating them with a conical probe, or in some cases by making a small incision.

Eversion of the lower lid renders it impossible for the lower canaliculus to perform its function. The consequent overflow of

tears, and the constant wiping of the eyes, give rise to eczema of the lower eyelid. This inflammatory state increases the tendency to ectropion, and a vicious circle is thereby created.

Frequently, we are unable to detect any of these causes of epiphora. The affected individuals are young, and often in the best of health; the lacrymal passages are freely patent; and no defect can be found in the lids: yet the tears constantly overflow. Careful examination, however, reveals the fact that the lower lid is separated from the globe by a thin layer of fluid. If, too, we draw the lid away from the eye, it shows a lack of elasticity, and returns slowly to its place. These signs are probably due to some faulty nerve tone, perhaps chiefly affecting Horner's muscle.

Kuhnt in this paper does not deal with the treatment of epiphora due to obstruction of the lacrymal passages, nor to defects of innervation. He confines himself entirely to epiphora caused by anomalous positions of the lids.

If the limp condition of the lower lid has given rise to a definite elongation of the lid edge, it is obvious that the latter must be shortened.

Early in the nineteenth century, Adams proposed an operation which consisted in the removal of a wedge-shaped portion of the whole lid—conjunctiva, tarsus, and skin. This operation fell into disrepute, for faulty healing led to the formation of a coloboma of the edge of the lid.

In 1883 Kuhnt removed a wedge from the tarsus, which, of course, included the conjunctiva, towards the nasal end of the lid. This operation was very like one performed in past time by Antyllus, an operation long forgotten.

Kuhnt operated as follows.—The lower lid was grasped in a triangular clamp and everted (Fig. 1). After accurate estimation of the amount to be removed, a triangular portion of conjunctiva and tarsus was marked out with a small scalpel, and excised; care being taken that the triangle was isosceles. The lid-margin was then split along the base of the wedge just behind the cilia, to a depth of 3 mm. Then, the tarsus was seized with forceps, and dissected away from the muscle layer. The edges of the wedge were now approximated with a suture. This operation has, on the whole, proved satisfactory.

It has been objected that the sutures are apt to cut out too soon, and that an ugly lump is formed upon the skin. Kuhnt points out that if the base of the wedge be not too long, the suture rarely cuts out prematurely. The skin-fold can be avoided if the sutures be inserted by the method which is shown in Figure 3. To obtain good apposition of the edges of the tarsus, it is necessary to carry the incisions off the tarsus and into the lower *cul-de-sac*. The stitches should be passed obliquely, so that, when they are drawn tight, the tarsus is somewhat raised.

The wound is finally powdered with noviform (now called doriform), and a binocular bandage worn for 6 to 7 days.

When, as in old persons, the tissues are very loose, Snellen's sutures are inserted.

If the wedge operation be not completely successful, Kuhnt proceeds to an operation for eversion.

FIG. 1.

FIG. 2.

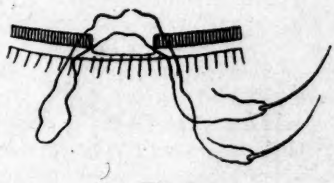

FIG. 3.

Starting at a spot 3.5 mm. to 4 mm. from the outer edge of the lid, a half-curved needle is passed through it from without inwards; the needle is seized anew, re-entered close to its point of exit, and passed upward until it appears at the inner lid margin. It must include the whole thickness of the tarsus. Finally, the needle is returned through the lid from within outwards, appearing just below

its original point of insertion. The suture is carefully tightened, and knotted in a bow over a glass bead or roll of gauze. Three such sutures are necessary. The stitches are tightened up a few days later, until eventually they cut out.

The forceps shown in Figure 2 simplify the introduction of the threads.

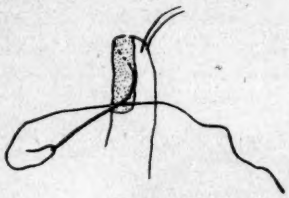

FIG. 4.

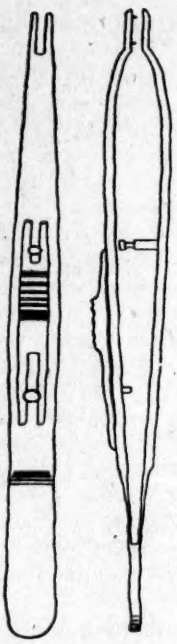

FIG. 5.

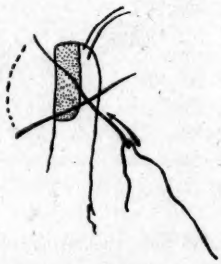

FIG. 6.

Figure 4 makes the whole method quite clear.

A simpler operation, which is equally efficient, is illustrated by Figure 6.

The lower lid is seized with the split forceps shown in Fig. 5, close to the punctum. A small straight needle is entered through the skin 3.5 mm to 4 mm. below the outer margin and directed upward to appear just below the inner margin. It is re-entered at a spot 4 mm. to 5 mm. lower down, and passed outwards through the whole lid until it appears above the point of original entry. It is knotted, as before, over a roll of gauze. Three or four such sutures are inserted along the lid.

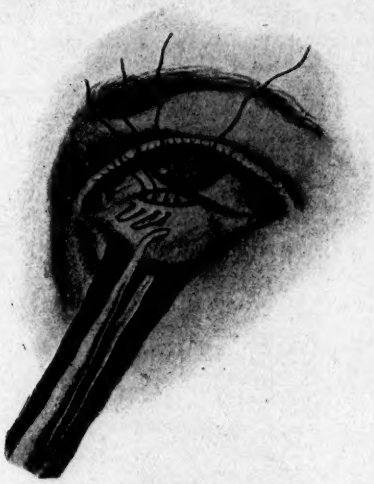

FIG. 7.

Bad cases of eversion are often not cured by these measures. There remains still another method of attack, which is shown in Figure 7.

The lower lid is grasped at about the middle of its nasal third, and ectropionised as much as possible over a horn spatula. The patient is told to look up strongly, and the conjunctiva is incised along the tip of the spatula from the inner canthus to about the centre of the lid. It is grasped with forceps, and separated up to the edge of the tarsus. Sutures are passed, as shown in the diagram, the spatula is removed, and the lid pulled upwards and outwards. The needles are now made to pierce the skin, and are knotted over rolls of gauze. It is necessary to produce an over-effect. The sutures should be allowed to cut out, but if they do not, they must be removed.

All the foregoing operations may be performed under local anaesthesia.

T. HARRISON BUTLER.

(2) **Kuhnt** after pointing out the futility of many methods of operating in cases of the kind described in the title of this communication outlines a plan which he has found satisfactory.

There is usually a mass of scar-tissue which must be cut away, and a large cavity is left. Unless this can be obliterated, the soft parts always form a fresh union with the underlying bone.

Fig. 3.

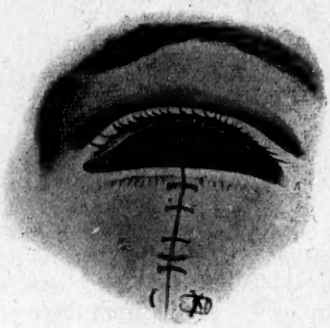

Fig. 4.

The essence of the new procedure is to fill the vacancy with a pad of fat taken from the thigh.

The plastic methods employed by him seem to be eminently practical, and can be grasped by a study of the diagrams reproduced.

The operation is carried out as follows:—

Stage 1. The edges of the cicatricial coloboma are pared down to the bone as shown by the lines a, a in Fig. 3. The cicatrix is now carefully excised without opening the antrum.

Stage 2. The limbs of the coloboma are now to be freely separated from the attachments to the underlying bone, as shown by the stippled area in Fig. 3. It is generally necessary to separate the tarso-orbital fascia, and to cut adhesions in the anterior aspect of the orbit itself.

Stage 3. The lid must now be shortened by cutting away the redundant conjunctiva and "cartilage." The coloboma is then lengthened by the incision (a^1), and a "V-shaped" incision (a^2 a^2) (Fig. 3) is made.

Stage 4. A mass of fat of sufficient size and appropriate form is now removed from the outer aspect of the thigh, and placed in the cavity left by removing the scar tissue. It may be advisable to fix it in place with a few fine catgut sutures.

Stage 5. The wound is united by a series of deep sutures which are tied in rotation from below upwards to prevent the fat wandering from the neighbourhood of the lid.

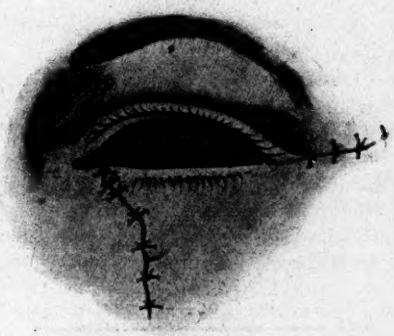

Fig. 6.

Stage 6. A triangular defect is now left by the gaping of the "V" cuts below. This must be sutured with two or three strong threads. If the defect cannot be so easily closed, it may be necessary to utilize a skin-graft. Figure 4 shows the final appearance.

Figure 6 illustrates an alternative method which is suitable for colobomata in the nasal side which are not directed outwards.

T. HARRISON BUTLER.

(3) This is a thesis by **Shine**, presented by the author for membership of the American Ophthalmological Society.

He reports six cases of the Motais operation for ptosis, of which he is an enthusiastic advocate. That it has not been more widely adopted in America may be explained, he thinks, by the fact that, in order to

secure good results, it calls for extreme patience and skill on the part of the surgeon. Motais, as is well-known, maintained that the slip taken from the superior rectus acquired a natural function of its own in so far as any independent action was concerned. Shine, however, agrees with Shoemaker in believing that the effect is due to a mechanical anchoring of the lid to a fixed point on the eyeball, the location of which is very close to that from which the lid is physiologically supported. The author enumerates the following as among the advantages of the Motais procedure.—1. There are no scars left in the skin, as in the operations that bear the name of Panas and Hess respectively. 2. A successful Motais gives a more normal appearance to the lid by pulling it up into a natural position. 3. There is little tendency to produce entropion or ectropion. 4. The operation is easily performed under local anaesthesia. 5. That no other function of the lid is interfered with, and that even if a Motais is not wholly successful, it does not prevent the performance of an operation of another character.

In regard to the six cases reported by Shine, 1 was a failure, owing to the suture slipping; 2 were partial successes; and 3 were successes. In 1 instance, entropion was present for a few days after operation, and an adhesive strip was employed to overcome the deformity. In another case, in a lad, aged 9 years, affected with marked congenital ptosis of one eye, the deformity was corrected by the Motais procedure. Upwards of two years after operation, the patient was found to have 5° of hyperphoria, combined with esophoria of 10°. Hypermetropia was present to an unequal degree in the eyes. Diplopia was not complained of.

S. S.

5.—Enucleation and its Substitutes

(1) **Carlotti and Bailleul.—Implantation of a piece of costal cartilage in the orbital cavity to obtain a mobile support for an artificial eye. (Implantation dans la cavité orbitaire d'un fragment de cartilage costal pour obtenir un support mobile de pièce artificielle.)** *Ann. d'Oculist.*, December, 1914.

(2) **Ray, Victor.—A new operation for the retention of a movable stump as a substitute for enucleation.** *Ophthal. Record*, April, 1916.

(3) **Story, J. B. (Dublin).—Fat implantation into Tenon's capsule after enucleation.** *Ophthal. Rev.*, June-July, 1916, and *Trans. Ophthal. Soc. U.K.*, Vol. XXXVI (1916), p. 263.

(4) **Ryerson, G. Sterling (Toronto).—On the selection of an operation for enucleation of the eyeball.** *Canada Lancet*, December, 1916.

(5) **Hall, Ernest A. (Victoria, B.C.).— Enucleation of the eyeball.** *Canada Lancet*, March, 1917.

(1) **Carlotti** and **Bailleul** have devised a new operation for improving the appearance and mobility of artificial eyes after removal of the eyeball. This consists in (1) removing a piece of costal cartilage with its perichondrium ; (2) removing the eye ; (3) dissecting a pedunculated flap of skin from the upper eyelid and passing it into the orbit through a button hole at the external canthus ; (4) suturing the skin flap to the cartilage ; (5) suturing the recti muscles to the cartilage ; (6) closing the wounds in the lid and conjunctiva. The skin flap is intended to supply nourishment to the cartilage and is sutured in front of it.

The authors claim to have obtained good results from this operation. R. J. COULTER.

(2) The operation devised by **Ray** consists of evisceration and the implantation of fat in the scleral cavity; but before the fat is introduced, a circular piece, about 20 mm. diameter, of the posterior pole of the scleral wall is excised, and along with this are cut the ciliary vessels and nerves and optic nerve at its entrance, or a quarter of an inch or more behind its insertion. The anterior scleral opening is closed by three silk sutures passed through the conjunctiva and sclera. J. JAMESON EVANS.

(3) Barraquez (1901) was the first surgeon to recommend the implantation of fat into Tenon's capsule after enucleation of the eye.

Story, who has performed the operation in eight cases, recommends his colleagues to try it. Story's *technique*, which is of home manufacture, may be described as follows.—After division of the conjunctiva, each rectus tendon is fixed in Prince's forceps before it is cut loose from the sclera. After the tenotomy, the internal rectus is transfixed twice by a catgut suture, the latter being left in the grasp of clamped forceps until after the fat has been inserted. By means of a second suture, the inferior rectus is treated in a similar fashion. The other two recti are not sutured, but are merely left in the grasp of Prince's forceps until the fat has been placed in position. In the next step, the eyeball is enucleated, and hæmorrhage is stopped by firm pressure applied to the orbit. The fat, taken from the abdominal wall through a short curved incision, is at once plunged into the capsule of Tenon, if the bleeding permits. The suture in the internal rectus is then knotted with that in the external rectus, and the suture in the inferior is similarly joined to the superior rectus. Both sutures

are left buried. Lastly, the conjunctiva is united by a continuous linear suture of silk or catgut, placed horizontally. A light bandage is applied for 3 or 4 days. The conjunctival suture is removed by the fourth day, or perhaps sooner.

As regards complications in Story's eight cases, in one he found it to be impossible to obtain anything but conjunctiva to cover the implanted fat, but the eventual result was good; and in another, bleeding came on from the abdominal wound, accompanied with violent vomiting. S. S.

(4) **Ryerson** recommends a modified simple enucleation of the injured eye in cases where symptoms of irritation or inflammation have made their appearance in the other eye. The four recti should be caught up by a needle armed with catgut before they are detached from the globe, and afterwards drawn together. The conjunctival opening should be closed by a purse-string suture. Haemorrhage is usually slight, and can be controlled by sponges wrung out of hot water. Care should be exercised, however, that the water is not too hot, since the author has seen a bad burn of the conjunctiva, followed by sloughing, caused in that way.

To Ryerson it has always seemed "a brutal and unscientific procedure to remove an eyeball, leaving a sunken socket in which an artificial eye lay motionless and staring." To him, Mules' operation has never been the operation of election. Under ordinary circumstances he believes that the best and safest method of removing the eyeball is by a modified enucleation, with the implantation of a gold sphere in the capsule of Tenon. His objection to a glass globe is that in course of time the fluids of the orbit so act upon it that it becomes crystalline and friable, while one of silver causes argyrosis, and blackens the conjunctiva. Extrusion of the sphere can be avoided by quilting the capsule and muscles,

Ryerson does not wholly approve the employment of paraffin or the transplantation of masses of fat. S. S.

(5) **Hall** re-describes a method of enucleation he evolved some years ago. Details follow.—(1) General anaesthesia, and insertion of speculum. (2) Circular incision of sclera posterior to ciliary region and in front of the insertion of the recti. (3) Removal by sharp curette of vitreous, retina, and choroid. (4) Insertion of blades of speculum within the sclera, thereby exposing the interior of the globe. (5) The point of entrance of the optic nerve is caught with mouse-tooth forceps, the sclera is pierced with scissors, and the optic nerve is severed 20 mm. behind the junction. The circuit of sclera is then completed close to the nerve, and "the sclero-optic junction" is removed. (6) After checking hæmorrhage, the parts are irrigated with saline. (7) A small gauze drain is inserted in the sclera, and the sclera and conjunctiva are approximated vertically. (8) The drain is withdrawn after twelve hours.

The artificial eye is usually inserted within a week, and worn for a few hours each day. The movement of the prothesis is free up to twenty degrees vertically, and to about thirty-five degrees horizontally. Hall's procedure, of course, is not applicable in malignant disease. S. S.

6.—Trans-Callosal Puncture in Choked Disc

Dutoit (Montreux).—Some results of palliative treatment of choked disc. (Algunos resultados del tratamiento paliativo de la papila estrangulada en los tumores cerebrales.) *Anales de Oftal.*, January-February, 1915.

Clinical experience has shown that the condition of papill-œdema, at least in its early states, gives rise to no disturbance of function. After a time, diminution of visual acuity begins, and increases rapidly, until total blindness is established.

It has been proved that the best chance of relieving the condition is by lowering the intracranial tension, and that this must be done early before the visual acuity has begun to fall, or the progressive loss will not be stayed.

The best result has been obtained by trephining, but recently lumbar puncture has been used as a preliminary substitute for trephining, since it is much less dangerous, and can be followed, if inefficient, by the larger operation.

There has recently been suggested puncture of the corpus callosum as a palliative measure in these cases. In certain forms, especially in cases of hydrocephalus, puncture of the corpus callosum would seem to be as efficacious as trephining, and in these cases, **Dutoit** is inclined to recommend it; always with the recommendation that it be done before the vision has begun to fall.

HAROLD GRIMSDALE.

7.—Conjunctival Flaps

Kalt (Paris).—On the technique of covering the cornea with conjunctiva. (Sur la technique du récouvrement conjonctival de la cornée.) *Ann. d'Ocul*, January, 1916.

Kalt considers that the best treatment for severe corneal wounds is to cover them with a conjunctival flap; but to be really efficacious, the covering must be maintained for several weeks. To secure this, he proceeds as follows:—1. A subconjunctival injection of 1 c.c. of 2 per cent. cocain solution is given. 2. A

circular incision is made, freeing the conjunctiva beyond the insertions of the recti muscles. 3. The conjunctiva is drawn forwards by 2 pairs of forceps, applied one at each end of the horizontal diameter, and the circular opening is thus transformed into a vertical slit. 4. The forceps are replaced by loops of thread which are held by an assistant drawing the conjunctiva forwards. 5. U-shaped sutures, 5 in number, are passed through the two layers of conjunctiva 4 mm. from the free margin and tightened, so as to bring the raw surfaces of the conjunctiva into contact without cutting the tissue. The sutures are left in for ten days, and the corneal covering will last for a month, when a cut of the scissors allows it to retract to its normal position at the limbus. The removal of the threads is facilitated by tying them across fine india-rubber tubing.

R. J. COULTER.

8.—Operation in High Myopia

Thompson, A. Hugh (London).—Late results of operative treatment of high myopia. *Ophthal. Rev.*, January, 1916.

This paper by **A. Hugh Thompson** records the progress of the cases on which he had operated and reported in the *Ophthalmic Review* in 1910 (Vol. XXIX, pp. 321-35). He says he has become more chary of recommending the operation, but that in carefully selected cases a satisfactory result may be obtained. He has been able to follow up the course of events in 14 out of 19 patients (15 eyes).

One was a failure from the first, owing to cyclitis.

One needling of congenital dislocated lenses with good result.

Three good results for 4 years, then lost sight of. Ten had better vision after operation than before, 9 getting 6/24, 6/18, and 6/12 without glasses; 1 had a macular hæmorrhage eight months after operation which cleared up leaving a vision of 6/12.

Five cases have failed after good sight for periods up to ten years, 3 showing macular degeneration, 1 developing cyclitis, possibly due to pyorrhoea, the other a large patch of choroiditis with keratitis punctata (formerly described as probably detachment).

A. H. PAYAN DAWNAY.

IV.—REMEDIES

(*Fifth Notice*)

(1) **Hamilton, Robert J. (Liverpool).—Acute glaucoma following the application of cocaine drops.** *Liverpool Medico-Chirurgical Jl.*, Vol. XXXVI, Parts I and II, 1916, p. 156.

(2) **de Peyrecave (St. Etienne).—The treatment of retinal detachment. (Du traitement des décollements rétiniennes.)** *La Clinique Ophtal.*, February, 1917.

(3) **Schoenberg, Mark J. (New York).—The intracranial treatment of syphilitic and parasyphilitic affections of the optic nerve. (Le traitement intra-cranien des affections syphilitiques et parasyphilitiques du nerf optique.)** *La Clinique Ophtal.*, February, 1917.

(4) **Charles, J. W. (St. Louis).—Optic nerve involvement in sphenoidal and ethmoidal disease with rapid diminution of vision following the administration of salvarsan.** *Amer. Jl. of Ophthal.*, February, 1917.

(5) **Jones, E. L. (Cumberland, Maryland, U.S.A.)—Subconjunctival injections of mercury cyanide in ocular therapy.** *Amer. Jl. of Ophthal.*, March, 1917.

(6) **Woods, Hiram (Baltimore).—Some phases of the diagnostic and therapeutic uses of tuberculin in uveitis, illustrated by four cases.** *Ann. of Ophthal.*, April, 1917.

(7) **Hernaman-Johnson, Francis (Aldershot).—The use of X-rays in hyperactivity of the ductless glands, with special reference to exophthalmic goitre, and certain forms of ovarian dysmenorrhœa.** *Practitioner*, July, 1917.

(8) **Aikins, W. H. B. (Toronto).—The established value of radium as a therapeutic agent.** *Ibidem;* and *Canada Lancet*, July, 1917.

(9) **Bradburne, A. A. (Manchester).—Some phases of modern ocular therapeutics.** *Med. Press and Circular*, July 18, 1917.

(10) **Ellis, Henry A. (Middlesbrough) and Gay, H. M. (Middlesbrough).—Treatment of tuberculous eyes by local application of tuberculin.** *Lancet*, August 4, 1917.

(11) **Lamb, Robert Scott (Washington, D.C.).—Fibrolysin in the treatment of ocular diseases.** *Arch. of Ophthal.*, Vol. XLVI, No. 3, 1917, p. 233.

(1) **Hamilton** gives particulars of a case of double acute glaucoma, in a man of 61 years, following the application to the eyes of five or six drops of a five per cent. solution of cocain. One optic disc was slightly cupped and white. Double iridectomy

was performed without delay, and one eye recovered V. of 6/6, while the other, when estimated three weeks after operation, had regained only the faculty of counting fingers.

Cases of the kind by Hinshelwood (1900) and Snell (1901) a mentioned by the author.

S. S.

(2) **de Peyrecave** has had five definite cures of myopic retinal detachment out of seven cases treated. The treatment consists in absolute rest in bed, and the injection subconjunctivally, twice weekly, of acoin-gelatine-saline, the chloride of sodium being in 20 per cent. strength. As the treatment seems to present nothing particularly novel, one must suppose that the author has been singularly fortunate.

ERNEST THOMSON.

(3) The article by **Schoenberg** is important and deserves to be read in the original, but an attempt may be made to present the main points of the argument.

In the course of some researches in which sera were injected by the intraspinous method with the intention of reaching the central nervous system, the author found that he was unable to produce anaphylactic "accidents" in the optic nerves. This fact set him thinking. Does serum introduced into the spinal canal ever reach the optic nerve? If not, do the various therapeutic agents introduced in this way in the treatment of general paralysis, primary optic atrophy, etc., reach the optic nerves? If these sera and drugs do not reach the optic nerves, what is the best way to get them there?

The optic atrophy of general paralysis and of tabes is undoubtedly syphilitic, but why does specific treatment not work? The mere fact that spirochaetes have not been found in the optic nerves does not prove their absence. Assuming that primary optic atrophy is due to spirochaetes, how are we to reach them? Intraspinal treatment has proved the efficacity of direct application of medicament in spinal syphilis.

The author next gives a *résumé* of the anatomy and physiology of the lymph spaces of the central nervous system and of the composition and physiology of the cerebro-spinal fluid. It appears that the fluid passes from the cranium to the spinal canal rather than the opposite way. In the final paragraph of this he points out that the choroid plexuses form an effective barrier against substances introduced into the blood. Chlorides, bromides, iodides, nitrates, ferrocyanides, salicylates, acetates, methylene blue, fluorescein, bile pigments, mercury and arsenic cannot normally penetrate to the cerebro-spinal fluid. Volatile substances like ether and chloroform and, curiously, hexamethylamin pass into it. It appears therefore that the choroid plexuses stop all antisyphilitic drugs.

Schoenberg proceeded to experiment with a cat, two rabbits, and twenty-five dogs, in order to ascertain whether he could produce colouration of the optic nerves by injections into the blood, the spinal canal, the sub-dural space, or the venticles. For the most part he employed methylene blue in artificial or actual serum (ox). The methods in each case are summarized. Of these various routes the only one which led to colouration of the optic nerves was the intraventricular.

The author then discusses the pathology of parasyphilitic affections of the optic nerves. He gives reasons for holding with Stargardt and others that the supposition that the ascending "parenchymatous" atrophy of tabes and general paralysis, which has been held to be primary and toxic, not preceded by inflammation, and to start from the ganglion cells of the retina and be particularly resistant to treatment, must be considered to be incorrect. This form of atrophy is really due to exudative foci, caused by the migration of spirochaetes in the cerebro-spinal fluid and the blood. (The original must be consulted for details.) The reason (according to Schoenberg) that antisyphilitic treatment of so-called primary atrophy of tabes and general paralysis does not succeed, is that the therapeutic agent does not reach the site of the lesion, or, if it does reach it, the dose is so feeble as to be a stimulant to the spirochaete.

In order to reach the optic nerves, we must introduce the therapeutic agent directly into the encephalic sub-arachnoid space, so that contact may be made with the spirochaetes in the perineural spaces and optic sheaths. According to Hamill, one can inject with impunity 100 to 200 times more salvarsan into the cranium than into the spinal canal (*sic!*) In order to be successful, the diagnosis must be early before the spirochaetes become inaccessible and the lesions irreparable. ERNEST THOMSON.

(4) **Charles** relates the case of a waiter who consulted him on account of deterioration of vision and headaches. The discs were slightly hyperaemic and streaky, the blind spots enlarged, and the fields narrowed for colours only. R.V. 23/96, L.V. 23/24. He was referred to Sluder, who ascertained that he suffered from "a hyperplastic sphenoiditis and ethmoidal abscess." Immediate operation on the sinuses was recommended. The patient procrastinated, but was induced to have a Wassermann, which was highly positive. He again procrastinated, but one month after the original examination, when the vision of the right eye was 23/120, and of the left 23/24, he received by the intravenous method 0·5 grm. of salvarsan. On the second day the vision of the right eye was 4/240, of the left 23/48. Nothing was discovered with the ophthalmoscope. A fortnight after the injection of salvarsan, the right eye had vision 23/192, the left 23/150.

The question that arises is whether the optic nerves were directly damaged by the salvarsan or by a tissue reaction round them. The author concludes that since it is "fairly well agreed that salvarsan is not neurotropic" two factors are necessary for a reaction in a nerve, namely, the presence of spirochætes in the nerve and access of the salvarsan to them. He leans to the suggestions of Schoenberg that very little medication, if any, can reach the optic nerve, either from intravenous or intraspinous injection.

ERNEST THOMSON.

(6) **Woods** reports fully four cases of uveitis (believed to be of tuberculous nature), of which three were treated with tuberculin. In case No. 1, an instance of choroido-retinitis, permanent damage to vision followed a focal reaction after the injection of 0.5 mg. of tuberculin. In case No. 2, a rapid extension of choroidal exudate succeeded the subcutaneous injection of 0.001 mg. of tuberculin, which produced a general and a focal reaction. When the reactions had subsided, thirteen injections, spread over four months, were made of tuberculin, the strength of which was gradually increased to 0.01 mg., with benefit. In case No. 3, one eye had already been lost from uveitis. The other eye showed a steamy cornea, keratitis punctata, posterior synechiæ, and turbid vitreous. V. was hand movements at two or three feet. The von Pirquet test produced a general and a local reaction. The patient received twenty-two injections of tuberculin (1/10,000 mg. to 1/1,000 mg.) spread over a period of about three months and a half, the eye being treated with atropin and dionin. He regained normal central vision. When seen upwards of five months afterwards, V. was 20/20, and the patient appeared to be in good health. Woods's fourth case was in a woman, 45 years of age, whose right eye had been rendered useless in 1907 by disseminated choroiditis with central atrophy. In 1913 she was again seen on account of recurrent redness in each eye. The better eye showed disseminated choroiditis, large scotomata, and "punctate keratitis." von Pirquet's reaction was positive. Tuberculin (in doses of from 1/1,000 mg. to 2/100,000 mg.) was injected once a week for six months, and for a month an addition of 1/100,000 mg. was made to the weekly dose until the latter reached 8/100,000 mg. At about this time a diminution in the size of the scotoma was noted. A weekly injection was continued for about a month longer. Shortly after this, redness appeared in the right eye, and this led to a renewal of the injections in an initial dose of 2/100,000 mg. every ten days, increased as before. After fifteen months of treatment there was a marked improvement in the scotomata; and five months afterwards, when tuberculin was discontinued, V. was 20/15. Three months later small scotomata reappeared, and tuberculin was given as before, the dose being gradually increased to 8/100,000 mg. There were other fluctuations in the condition

of this patient; but briefly the points to be noted were: tuberculin treatment of eight months' duration before improvement; relapse during twenty-two months whenever injections were discontinued; and then a year without symptoms and without treatment.

Woods deprecates obtaining a focal reaction with tuberculin on account of the risks involved, and insists that there is no need to elicit such a reaction, so far as diagnosis is concerned, since in a given case there may be a history of exposure to tuberculous infection, no other cause can be found to account for the ocular lesions, and a positive von Pirquet may be obtained. He suggests that it is safer to begin with minute therapeutic doses of tuberculin and gradually to increase them until the patient's point of tolerance is found, rather than to insist upon a diagnostic focal reaction to begin with.

In Woods's view, the following conclusions represent the proper attitude of ophthalmic surgeons towards the use of tuberculin for diagnostic or therapeutic purposes:—

1. Avoidance of focal reaction in intra-ocular lesions.
2. Avoidance of tuberculin as a therapeutic measure in acute cases. Under "acute" should be included duration and advance of the lesion, as indicated by the condition of the vitreous, keratitis punctata, and so forth.
3. Tuberculin is indicated when the lesion is non-progressive, but does not get well.
4. A positive von Pirquet, with elimination of other causes, is sufficient basis for the use of tuberculin in therapeutic doses.
5. The present status of vaccine therapy is so uncertain that ophthalmologists owe it to their patients to conduct this treatment under the guidance of one trained in problems of immunity. S. S.

(7) **Hernaman-Johnson** speaks highly of the effect of the X-rays in cases of exophthalmic goitre. In order to obtain the quickest results, sittings must be given three times weekly at first, comparatively small doses being employed. In acute cases, threatening life, the apparatus should be set up in the patient's room, and treatment be adminstered daily for at least a week. With modern equipment there appears to be no difficulty in setting up silent running apparatus in a private house. Alarming noises can be obviated by careful preparation. The most serious cases often seem to do the best. Most of what it is possible for X-rays to accomplish can usually be done in three months, although under some circumstances occasional short courses may be necessary at a later date. The X-rays particularly influence the pulse-rate, tremors, and sweating, and have less influence upon the obvious physical manifestations of the disease, as exophthalmos and thyroid enlargement. Among the causes of failure, the writer includes excessive worry and overwork,

intestinal stasis, septic absorption from the mouth, naso-pharynx, or pelvic organs, and, lastly, deficiency in some internal secretion other than the thyroid. Briefly, X-rays are a specific for exophthalmic goitre in the sense that the secretion of the thyroid may be diminished to any required degree. In rare cases, when the secretion is seriously vitiated in quality, suppression may have to be carried so far that subsequent permanent thyroid feeding is necessary. Cure cannot be effected in the presence of any persistent irritation, mental or physical.

S. S.

(8) **Aikins** in reviewing radium as a therapeutic agent, speaks of its value in rodent ulcers, vernal catarrh, and exophthalmic goitre.

(9) **Bradburne's** communication consists in the main of an abstract of the article by the late Wendell Reber on "Some Phases of Modern Ocular Therapeutics," published in the May, 1917, number of this journal.

(10) The article by **Ellis and Gay** is of very great interest, though it may be admitted that the number of cases treated, thirty-three, is on the small side considering the importance which must attach to the communication if similar results are obtained by others. Put very briefly, the authors have found by means of the multi-papillary-cutaneous method that superficial chronic eye affections in children are much more often due to a tuberculous condition than would have been anticipated. Particularly interesting is what they have to say of blepharitis, where the eyelashes reappear after the cure of the tuberculous condition, though they have been absent for years. The upper lid has only been twice found affected, and that has been on its free border. "The upper sector of the eye (the authors are referring to superficial conditions) does not seem to suffer from tuberculous invasion in the same proportion as the middle and lower sectors. This is so marked that it suggests that disease may be largely due to the deposit of tuberculous infected dust finding a lodgement in the superficial ocular tissues. . . . The large proportion of girls affected (20 out of 33) . . . suggests that the dust is domiciliary rather than external." The reviewer would suggest, however, that on this point the numbers are insufficient for any definite statement. Having revealed by means of the M.P.C. method the widespread existence of tuberculous infections of the superficial ocular tissues the authors have proceeded to treatment by the local application of tuberculin. All the cases (blepharitis, phlyctenular conjunctivitis, keratitis) so far treated have, up to date, proved curable in six weeks to three months, and so far only one relapse has occurred after the completion of the treatment. The treatment consists in instilling tuberculin (bovine P.T.O.) in various dilutions of increasing strength. Classification into hypersensitive, sensitive, subsensitive and

insensitive is first obtained by cutaneous test, and then an appropriate dilution of tuberculin is employed for instillation. During the treatment the eye is kept uncovered, being protected by a shade only when photophobia is present. No atropin or other local drug is used except where the reaction is excessive. The details of the various dilutions, frequency of application, reactions, duplications of doses, and so on, in the various classes of case must be studied in the original to be of any service. The whole procedure is of great interest and the authors are clearly enthusiastic about their results. It is obvious, of course, that as the treatment can only be carried out at the clinic, or, at least, by a medical practitioner, or under such practitioner's direct supervision, it must involve a very considerable expenditure of time where very many children are in attendance. Nevertheless, if by this method permanent cures of a most intractable condition can be obtained, such time as is required will eventually be forthcoming.

ERNEST THOMSON.

(11) **Lamb's** first essay in the use of fibrolysin was in the treatment of vernal catarrh. In ten days he completely cured "six chronic recurrent typical and well-marked cases" by dropping one minim each night into each eye. This led him to apply it by injection to other conditions, including ulcerative keratitis, irido-cyclitis, exudative and hæmorrhagic retinitis, vitreous hæmorrhages, hyphæma, iridic adhesions, choroiditis, etc. He speaks enthusiastically of the results obtained, but warns surgeons against beginning with large doses; he thinks that the doses should be graduated according to the body weight, and in an average man he would begin with a dose of 1 cc. Unpleasant symptoms may follow, including marked depression, nausea and even vomiting for several hours, and weakness for some days. There is severe burning for several minutes at the site of the injection. He appears to prefer to make the injections in the back.

R. H. ELLIOT.

BOOK NOTICE

The Fundus Oculi of Birds, especially as viewed by the Ophthalmoscope: A Study in Comparative Anatomy and Physiology. By CASEY ALBERT WOOD. Illustrated by 145 drawings in the text; also by 61 coloured paintings, prepared for this work by Arthur W. Head, F.Z.S., London. Chicago: *The Lakeside Press*, 1917.

This handsome folio volume is the outcome of over ten years of patient and laborious investigation in a field of discovery very

little encroached on by ophthalmic surgeons. One need not have more than the slightest possible personal acquaintance with fundus work in living animals to appreciate the enormous amount of labour entailed in the present investigation. Wood's name stands for industry of the highest order, and his present work will adorn the literature of the subject and enhance his reputation.

The volume consists of 181 pages, and is furnished with 145 black and white drawings in the text, and by 61 paintings in colour prepared for the work by Arthur W. Head, F.Z.S., London, whose contributions to the illustration of animal and human fundi are already well-known and appreciated. The paper and type are above reproach, misprints are few and not of much importance, while a particularly pleasant feature is that opposite each of the coloured plates is a good description of the fundus appearances, which are given more fully in the text under the different orders of birds—this saves much turning of pages and helps greatly in appreciating the points made. There is no index, but the table of contents is ample enough to allow of ready reference to any important point.

The publishers are to be congratulated not only on the excellence of the paper and type, but upon the skilful reproductions in colour of Mr. Head's paintings, while the author is to be congratulated upon his extraordinary industry and the extent of his scientific knowledge of birds. A field knowledge of birds is not an uncommon accomplishment amongst medical men, but such deep insight into questions of classification as Wood shows, must be very exceptional, particularly in one whose life is so fully occupied otherwise.

A bibliography of 76 references—22 of which are English—is given, exclusive of the well-known, unspecified manuals of ophthalmology, ornithology, and biology which had helped the author most.

The author has used the systematic classification of Bowdler Sharpe's Hand-List of Genera and Species (London, 1909), except in the case of North American birds, when he uses the Check-List of the American Ornithological Union (1909).

As regards the scope of the work, Wood says that "The eyes of some representative of (practically) all the orders of birds and most of their backgrounds have been examined by him, and are more or less fully illustrated in this atlas. Moreover, some of the more important species were examined, not only ophthalmoscopically before death, but macroscopically afterwards. In addition to these methods of investigation extensive microscopic examinations of the the tissues were carried on especially in conjunction with Prof. J. R. Slonaker." Further, the eyes of some allied vertebrate species were examined for comparison, viz., particularly some of the reptilia—

gecko, toad, cobra. To show the variety of birds examined, one may mention the humming-bird, sparrow, apteryx, ostrich, cassowary, turkey, quail, wood-pigeon, Cape penguin, puffin, gull, heron, ibis, goose, duck, cormorant, pelican, vulture, secretary bird, eagle, owl, kestrel, bustard, parrot, kingfisher, cockatoo, nightjar, hornbill, cuckoo, wood-pecker, jay, bird of paradise, blackbird, raven, and many less familiar birds. Almost all those named have their fundi reproduced in colours. The eyes of many hundreds of species have been examined ophthalmoscopically and otherwise, but normal wild birds are alone to be depended on, as domesticated birds and birds after prolonged captivity vary too much. Many of the birds were examined in our own Zoological Gardens, others in New York, Chicago, and San Francisco, whilst specially prepared specimens came from such distant parts as Colombia, the Pacific Coast of America, and Australasia.

Details are given of the methods of examining the fundi of live birds, and some interesting points are given about artificial induction of mydriasis in birds, whilst full details are added about the use of Perenyi's Fluid for preserving and decalcifying the heads of birds obtained at a distance for macroscopic purposes.

Much useful information regarding the physiology of the bird's eye, especially with reference to the single macula, double maculæ and binocular vision, is given, while the subject of the pecten, its origin, and uses, is handled broadly, bringing out the point that the pecten is better developed the more the bird makes use of monocular vision, and vice versâ, the owl, for example, having a small pecten. Slonaker and Wood believe the pecten to be purely a nutritive tissue.

The difference between the general fundus colour of day and of night birds is very remarkably demonstrated.

The author makes an important classification of "Areas of Distinct Vision in Birds," of which there are at least six arrangements, the amacular, the nasal, and the temporal monomacular, the bimacular, the band-like central area and those with two macular regions, either joined to or associated with the band-like area—an arrangement to which Wood gives the name "Infulabimacular fundus"—to be found in the sparrow-hawk and in the tern. This has to do with the habits and habitat of the birds concerned.

He further classifies pectens in a manner which indicates the great width of view and variety of examples examined.

The author early came to the conclusion that there was no connection between plumage tints and fundus colouring.

His wide experience allows him to classify birds according to the pecten, to the areas of distinct vision, to the vascularity or avascularity of the fundus, coupled with the kind of fundus colour present.

Wood believes that as the fundus appearances in wild species are probably invariable, and that, as the evidence so far produced shows, each species exhibits a background picture distinct in one or more particulars from every other species, it is possible to identify many of them by the use of the ophthalmoscope alone. He has, further, been able to trace close relationships between apparently only distantly related or unrelated birds by noting the peculiar colour of the fundus, notably the yellow or orange tint so peculiar to birds of nocturnal habits.

Wood says that it is frequently possible to recognize a species by viewing its fundus oculi, and in this connection one may quote his last three conclusions in full :—

"As the coloured pictures seen in the fundi of healthy wild birds are invariable in species, these appearances may well furnish data for a classification of Aves ranking in importance with other taxonomic indications.

"Ophthalmoscopy throws light on the origin of birds, at least on their relation to that Sauropsidian ancestry which they hold in common with reptilia.

"In future no report upon a particular avian species can be held complete that ignores the visual apparatus, and especially the appearances of the fundus oculi as shown by the ophthalmoscope."

It is to be regretted that the author got only unsatisfactory results in his attempts at ordinary and colour photography, both of the living avian fundus and that of the prepared specimens. He looks hopefully, however, to the future; but in the meantime, unless the ophthalmologist is his own artist, some combination must be used on the lines of the present work. Wood acknowledges gratefully the help which he has received from his artist, Mr. Head, and the long series of beautiful reproductions in colour adds immensely to the value of the work, while they speak of the double labour of the ophthalmoscopic examination and of the delineation of the picture thereby presented to the eye. Further investigations on animal fundi, however much to be desired, will be curtailed by the difficulty of getting an artist competent to use the ophthalmoscope with intelligence to help an experienced ophthalmologist gifted with the skill and leisure to undertake the work. The combination of Wood and Head has been a fortunate one, and this work must for many years remain the standard work on this interesting subject.

The publication of any further researches by Wood on the eyes and eyesight of birds will be heartily welcomed by the ophthalmic world.

W. C. SOUTER.